Shadow ***Integrated Energy Policy (IEP)***

A critique on Planning Commission document on Integrated Energy Policy

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Executive Summary

Energy has become a crucial sector of the modern society, so much so that per capita availability of energy is considered as an indicator of economic prosperity. However, the social, economic and environmental impacts of demand/supply of energy are so great that only a holistic and objective consideration of all the related issues will enable the formulation of a sustainable and effective national policy. In this context an objective review of the recommendations of Integrated Energy Policy (IEP) document, as developed by Planning Commission of India, is considered essential from the society's perspective. In this critique it is noted that while there are many good recommendations in IEP, an objective review will indicate that IEP has projected huge growth (about 5 times from the present level) in the installed/ production capacity of various conventional energy sources by 2031-32 ignoring the huge negative impacts of such a growth on our society. Unfortunately, IEP has implicitly or explicitly adapted the GNP maximizing paradigm to estimate energy demand rather than trying to estimate what is the least amount of energy needed to wipe out poverty, and how best to meet it in a sustainable manner. It is because of GNP maximizing paradigm that IEP has projected a huge annual demand growth for electricity between now and 2031-32.

Despite an enormous increase in the installed capacity since independence about 40% of our households are denied electricity, and even the other 60% are not getting quality supply. Whereas there will be unsustainable pressure on natural resources of our society associated with a huge growth projection, the long term impacts of the same on the vulnerable sections of our society including the fragile environment and bio-diversity have not even been discussed. In this context alone the IEP as a policy document has failed to meet the expectations of a welfare society. But what we need is a totally different and Indian cultural biased approach, similar to the one which was recommended by Prof. Amulya Kumar Reddy way back in mid 80s. As a national policy IEP has failed to consider the welfare of all sections of our society on a holistic/ sustainable basis.

In view of the social, economic and environmental impacts of fossil fuels, and their limited availability, the country is in urgent need of a paradigm shift in the way it views the energy sector as whole. The past policy of looking at supply side economics only should be changed to a holistic approach of minimising the total energy requirements while ensuring equitable development of all sections. The legitimate demand for energy must be objectively considered in the correct context of greater needs of the society such as clean air, water and healthy food, and the inescapable limits of the nature in supporting such a demand. In this regard it becomes obvious that the conservation and enhancement of our environment and bio-diversity must not be compromised in order to meet the unabated demand for energy. Within the energy sector, there is a critical need to: clearly differentiate our needs from wants/luxuries; recognize the fact that fossil fuels are fast running out; focus on improving the energy efficiency to international best practice levels; effectively deploy all the alternatives available to meet the legitimate demand; and harness the renewable energy sources to the optimum extent.

In view of local environmental issues and Global Warming impacts of fossil fuels, it is right time to lean towards alternate energy sources such as solar, biomass, wind and other renewable sources on a decentralized basis rather than through centralised large size units. Decentralized systems will reduce transmission and distribution losses, and would also help in reducing the unacceptable levels of urban-rural disparity prevailing in power distribution. In view of the Global Warming impacts on our densely populated society the usage of fossil fuels should be minimised in the short run and eliminated in the long run.

There is no escaping the need to recognize the limits of the nature in supporting the ever escalating demand for energy; acknowledge the fact that the energy security will not be feasible as long as we fail to effectively manage the demand, and as long as we rely heavily on external resources.

Electricity being a precious national resource, suitable tariff policies, including a feed-in-tariff for renewable energy sources, should be implemented urgently to heavily discourage its wastage, and to encourage very high efficiency in its local production and usage. Subsidized electricity supply to any category of consumers should

be minimised, and if considered essential should be only through advance payment of one year's subsidy amount by a State Government to the supply company. A comprehensive policy to encourage widespread usage of pubic transport systems should be implemented; usage of private vehicles should not be encouraged keeping in view the huge cost of fuel imports, road infrastructure constraints, and the pollution impacts; old and inefficient vehicles should be eliminated on a rigid time scale; adequate investment in railways should be taken up on a war footing.

International best practice level efficiencies must be adopted at all stages of energy cycle by 2020; AT&C losses should be brought down below 10% in each revenue district of the country; the PLF of each coal /nuclear power project should be improved to a minimum of 90%; efficiency of end use applications, including agricultural pump sets should be comparable with the international best practices.

Costs and Benefits Analysis (CBA), from a societal perspective, should become a part of the mandatory approval process for all new power projects. Most of the newly permitted coal power plants should come up on the sites of existing old/ inefficient power plants and should be of much higher overall efficiencies and with low pollution footprints.

There shall be no supply to any consumer without accurate metering beyond 2015. 'Polluter pays principle' is a novel idea put to practice with the desired effects in many parts of the world, and it is best applied at the stage of mining and electricity generation itself. A suitably designed carbon tax should be applied to each ton of coal, litre of diesel/petrol, kilo litre of water and kWh of energy produced/ consumed/ generated so as to minimise the use of these resources for commercial purposes by 2020.

The last man on the street OR the most vulnerable sections of the society should be at the centre of our energy policy to enable adequate human development of the entire society, instead of focusing on growth of GDP alone.

IEP's projection that the total installed power generating capacity has to increase from about 160,000 MW to about 800,000 MW by 2031-32 will mean the addition of about 25,000 MW power capacity every year which is neither acceptable to the society because of huge implications nor feasible on the basis of what has been achieved in successive five year plans. IEP seem to have failed to take into account the impracticality of its recommendations.

IEP itself has many good recommendations such as focus on efficiency improvement, Demand Side Management(DSM), correct pricing of energy, R&D on alternative energy forms, equity in energy availability to the poor, Energy Service Companies (ESCO) etc.

In view of the huge influence of electricity sector on social, economic and environmental aspects of our society, much of the focus in this critique on IEP is on electricity sector. The main objective of the critique is not to comment on every issue raised in IEP, but to highlight the serious shortcomings in IEP; the impact of wrong policies on the society and bio-diversity; and to recommend a sustainable, people friendly and environmentally friendly energy policy.

1.0 Preface – the need for a shadow integrated energy policy

Integrated Energy Policy (IEP), as developed by the Planning Commission in 2006, is a crucial policy document, which is seen as guiding the medium to long term policy decisions of the government in the energy sector (http://planningcommission.gov.in/reports/genrep/rep_intengy.pdf). In view of the long term implications of its recommendations, there is a need for the civil society to critically examine the recommendations and apply course corrections, where necessary.

A quick overview of the IEP indicates that there are quite a few issues needing public debate because of the implications on sustainability and the long term impacts of social and environmental aspects. IEP refers largely to technical, economic and logistical issues but has ignored the hugely important social and environmental aspects of our society.

The objective in this critique is not to discuss on every issue raised by IEP document. The objective is also not to present a ready made action plan to the govt. for immediate implementation. The main objective is to highlight the serious shortcomings in IEP, the impact of these shortcomings on the society and bio-diversity; to emphasise that there is an urgent need for a paradigm shift on energy front; and to focus on sustainable, people friendly and environmentally friendly energy policies. Hence the emphasis has been on the order of magnitude than a high degree of accuracy while referring to the statistical information in this critique.

Some of the major concerns to our society as far as IEP document are concerned are:

- Projection for large additional power capacity based on continued high rate of demand growth;
- Advocacy towards heavy reliance on fossil fuels, especially the coal;
- Focus on large addition to hydel power capacity;
- Recommendation for huge increase in nuclear power capacity despite serious issues;
- Low level of confidence on renewables, as against international thinking;
- Focus largely on energy sources with grid interaction capabilities;
- Inadequate attention to social and environmental aspects of large additional capacity.

Of the various forms of commercial energy available to our society, electricity has an overarching reach to most sections of our society, and it is also considered the most convenient form of energy. As per IEP about 78% of the domestic coal production is being used for electric power generation (page XIV-Overview). The IEP projects that the composition of commercial primary energy sources in the country could be 50% of coal based electricity and about 29% of hydro electricity in 2031-32. Additionally, in Indian scenario the electricity production is associated with about 53% of all CO_2 production and about 24% of GHG production. About 33% of the commercial energy used in Indian households is in the form of electricity as per NSSO 55^{th} round. In view of this statistical strength the need for focusing on the electricity sector cannot be overemphasized. IEP itself has dedicated much of its focus on electricity sector.

There are credible reports to indicate that in excess of 5 Million people have been displaced since independence due to various development projects, including large power projects. A majority of such people are known to have become destitute in their own habitat because of insensitive rehabilitation

processes. Such large scale displacements are not in the best interest of the society. Large additions to conventional power projects will only exacerbate such problems.

As per the Finance Commission Reports the loss to the national economy because of the inefficiency in power sector is about Rs. 66,000 Crores per year, and which is expected to grow very steeply. Such a huge loss is denying the adequate fund allocations to other essential sectors of our society such as poverty alleviation, drinking water needs, health, education etc.

The forest and tree cover in the country has reduced from about 40% at the time of independence to less than 23% as of now with huge implications on our general environment, bio-diversity, and natural support bases for the masses. Large number of additional conventional power projects will only exacerbate these problems, and will make it impossible to meet the 335 target under National Forest Policy.

In view of the huge influence of power sector on social, economic and environmental aspects of our society, there is an urgent need for the society to take a holistic review of the entire power sector, and hence much of the focus in this critique on IEP is on power sector. This in no way reduces the importance of other energy sources such as petroleum products and non-commercial energy sources to rural households.

2.0 Realistic Electricity Demand projection – a crucial aspect of the future planning

A major issue with IEP is its high electricity demand growth projection by 2031-32. It assumes that to eradicate poverty the economy has to grow at 8 - 9%, and to support this much of growth and to meet the lifeline energy needs of the masses, the commercial energy supply would need to grow at about 6 % per annum upto 2031-32. In order to achieve this growth IEP has projected the installed electricity generating capacity to increase from 153,000 MW to 778,000 MW by 2031-32. This projection of 5 times increase in electricity generating capacity seems to be based on the assumption of high demand growth by conventional demand projection methods. This comes to about 6.4% CAGR w.r.t the base figure of 153,000 MW in 2006. Such a growth rate in coal consumption will put tremendous pressure on the entire coal energy cycle, including the coal mining operations and the coal transportation infrastructure. Our democratic society, with a number of vulnerable sections, will find it impossible to deal with such huge demand increase for coal/electricity effectively.

The major concern with such a high electricity demand projection is that all the planning agencies of the Union government and state governments are likely to proceed with gusto to achieve that generation capacity target without much ongoing analysis of the prevailing conditions. The big question is; whether our society can afford such a huge additional demand on the grid, even though all of such additional demand may not contribute to the economic development or may not lead to true welfare of our masses. But the social, economic and environmental impacts of such a huge addition to the installed capacity will be enormous, and can defeat the very purpose of high GDP growth, which is the all round welfare of every section of our society. Hence there is the inevitability of limiting the true electricity demand, and hence the corresponding total installed power capacity within manageable limits keeping in view the nature's limit in supporting such a growth and the developmental needs of all sections of our society.

IEP in its discussions on future energy demand acknowledges the falling elasticity of electricity consumption/generation in the 13 years period between 1990-91 and 2003-04 as compared to the 23 years period between 1980-81 and 2003-04 (IEP: page 18-20). This observed drop in elasticity from 1.3 to 1.06 has been projected to continue to drop to 0.78 for the 10 year period from 2021-22 and 2031-32. IEP also clearly acknowledges that energy elasticity of GDP can be shaped by policy interventions, the relative price of fuels, changes in technology, changes in end use efficiency of equipment, the level of energy infrastructure and development priorities that affects the structure of economy (IEP: page 18). In this context instead of recommending effective action plans to reduce the effective demand for electricity, IEP seem to have taken a path of high demand growth on the basis that the population will increase and the purchasing capacity of the general population associated with 8% GDP growth will increase. Such a projection seems unrealistic for the reasons discussed in the following paragraphs.

It also appears that the electricity demand projection in IEP has been influenced considerably by the methodology used by Central Electricity Authority (CEA) in its periodic Electric Power Survey (EPS) reports. Hence it is relevant to throw light on how CEA goes about such demand projections.

CEA, in *Report on Seventeenth Electric Power Survey (EPS) of India,* has projected compound annual growth rate (CAGR) of electricity consumption at the rate of 10% up to 2012 and 9% up to 2022. The projected demand for peak load power is assumed to grow in same ratio. These two figures are very high and seem to have been arrived at through very conventional methods without factoring in the changes in the consumption factors. Dr. Bharat Jhunjhunwala, a development economist, has done a detailed study of the methodology used in CEA electricity projection ("Economics of Hydro power", Bharat Jhunjhunwala, Kalpaz Publications).

He has concluded that the basis on which very high projection of electricity demand has been made is on certain wrong assumptions wherein previous 30-year growth rates are used to make forecast for future consumption of electricity instead of the latest 5 year growth rates. The 17th Power Survey gives the following data (table 1):

Table 1: **Basic data from 17th EPS**

Sl No	Time Period	Electricity Consumption CAGR%	Gross Generation CAGR%	GDP (93-94 prices) CAGR%	Elasticity Ratio Consumption/ GDP	Elasticity Ratio Generation/GDP
1	30 Years: 2004-05 to 1974-75	6.87	7.47	5.40	1.27	1.38
2	5 Years: 2004-05 to 1999-00	4.30	4.37	5.90	0.73	0.74

It is clear from above table that there is a steep decline in CAGR of electricity consumption from 6.87% in last 30-years to 4.30% in last 5-years. Yet, in making forecast, CEA relies on the larger 30-Year CAGR and ignores recent 5-Year CAGR. The declining elasticity of electricity consumption in our economy is significant but wholly ignored in CEA projections. The same argument seems to hold good for the demand projection by IEP.

Table 2: 5-Year growth rates (From 17th EPS)

Sl No	Period	GDP Growth Rate (Table 1.6)	Electricity Generated (Table 1.24B)
1	1996-97 to 2001-02 (Actual)	5.9%	5.8%
2	2001-02 to 2005-06 (Actual)	6.9%	4.8%
3	2005-06 to 2010-11 (Linear Projection)	8.0%	4.0%

The 30-Year and 5-Year figures can be used to estimate the actual long-term trend of increase in electricity consumption from the data given in 17th EPS. Accordingly, the CAGR of electricity consumption in 2004-05 is only 3.8%. This is close to the linear projection of 4% growth in 2005-06 to 2000-2011 made above in 17th EPS data. CEA data indicates that GDP growth in India has exceeded that of electricity consumption in the 5 year period of 2004-05 to 1999-00 by a good 1.6%. This clearly indicates the continuous delinking of growth in our economy from the electricity consumption.

The share of service sector in our GDP is increasing rapidly as against agriculture or even the industry. This sector consisting of segments like IT, BT, Tourism, Telecom, healthcare etc. has taken off in a grand manner after the liberalization in 1990. It is well known that the services sector consumes electricity only in small quantities. In view of the unmistakable trend of increasing contribution of services sector to GDP but decreasing share in electricity contribution, we can say that the overall economy will not need huge additional electricity for growth. On the other hand the change in consumption by domestic sector, as per CEA data, is large at 3.9% (between 2005-06 and 2011 -12). This means that we need electricity for consumption and raising the standards of living by the people. While entirely laudable, this fact gives an entirely different dimension to the increased generation of electricity. Generation of electricity for economic growth may be expected to provide trickle-down or secondary benefits while that for consumption does not. CEA fails to recognize this and passes off increased need for electricity as necessary for economic growth while it is largely for consumption.

Dr. Jhunjhunwala quotes Patrick McCully in "Silenced Rivers" that the over projection of electricity demand is a regular pattern adopted by most bureaucracies: "Electricity demand forecasts consistently overestimate future needs for electricity. In more than 100 national demand forecasts used by the World Bank, actual demand seven years after the forecasts were made was on the average one-fifth lower than that had been projected. The deviation between projected and actual (demand) increased with the number of years from the date of forecast."

Electricity prices are assumed by CEA to grow by two percent per year despite increasing role of private sector in electricity generation and distribution. While this assumption can be viewed as negation of the entire philosophy of liberalization and privatization, it would be appropriate to estimate lower demand for electricity due to higher price. This is ignored by CEA. This is especially important for demand during peak load hours of the day. In this way CEA seem to be variously making excessive projections of electricity requirement.

Dr. Jhunjhunwala concludes: "The unmistakable conclusion is that CEA has deliberately ignored its own latest 5-Year data and relied on the previous 30-Year data to make excessive forecasts of electricity consumption. These forecasts have then become the basis of India bending to make an agreement with the U.S. for nuclear power and the country destroying its rivers and land mass for generation of hydropower."

IEP's projected installed power capacity of 778,000 MW by 2031-32 appears to be unrealistic due to various factors: international efforts are accelerating to contain the Global Warming through measures such as energy efficiency improvement, energy conservation, demand side management (DSM); there are increased use of distributed type renewable energy sources; international co-operative efforts are gaining momentum to reduce the use of fossil fuels; India has launched 8 national missions, including one on energy efficiency, to combat Global Warming. All these measures, if undertaken earnestly, will reduce the effective demand for electricity by a considerable margin. Additionally, since this projection is on the assumption that the electricity demand will grow at 6.4% CAGR, even the decreasing elasticity of demand due to strong growth in services sector is wholly ignored. Hence it is realistic to say that IEP projection of 778,000 MW installed power capacity by 2031-32 is grossly exaggerated, and hence should be a concern because on the basis of such projection massive power capacity addition can happen at huge avoidable costs to the society.

Installed power capacity in the country has grown at 5.87% per annum over 25 years period previous to 2003 as per IEP. Despite such massive increase in installed power capacity during the previous 25 years, about 57% of the rural households and about 44% of the total households in the country did not have electricity in 2000 as per IEP (section 1.1). Many reports indicate that even in 2009 more than 40% of the total households in the country did not have electricity. IEP recognizes that the energy intensity of our economy has been falling, and is half of what it used to be in the early 70s but there is significant room to improve (page 48).

Whereas the assumption that a high GDP growth rate of 8-9 % through 2031-32 will alleviate poverty in the country early due to trickle down effect is itself seriously questioned, it should be noted that the huge growth in the installed power capacity during 62 years has not been able to provide even the life line electricity to 44% of the households. Various official reports, (including the ones from Central Electricity Authority, Central Statistical Organisation, Replies to Parliament questions etc.) have indicated a massive increase in electricity generating capacity since independence. Installed electricity generating capacity in the country has grown phenomenally from about 1,400 MW in 1948 to about 157,000 MW in Feb 2010; an increase of 110 times. Annual electricity generation from all sources has increased from about 61,000 MU in 1970-71 to 724,000 MU in 2008-09 an increase of 12 times in 30 years. The national per capita consumption has gone up from 238 kWH in 1989-90 to about 660 kWH in 2009, an increase of more than 2.5 times in 20 years. Despite such phenomenal increases in generation capacity since independence, about 44% of rural households are still deprived of electricity connection, and various forms of electricity crises are continuing even after 6 decades of self rule. So, massive addition to generating capacity cannot be seen as the panacea for our energy problems.

The total installed generating capacity in the country has gone up from 58,012 MW in 1989 to 1,52,148 MW in 2009, a whopping 162% increase. Total monthly generation from conventional sources has increased from 43,596 MU in March 2000 to 65,057 MU in March 2008, an increase of about 50%. National per capita electricity consumption has gone up from 283 kWH in 1992-93 to 429 in 2005-06, an increase of 52%. But 44% of the households, mostly in rural areas, have no access to electricity even in 2009.

(Source: as per Central Statistical Organisation (CSO) & Press Information Bureau, Govt. of India)

Whereas Indian government's stand in international Climate Change negotiations is that it should have no obligations of targeted reduction of GHG emissions because its per capita GHG emissions is much below the world average, the energy profligacy and inequitable energy consumption pattern within

India should be of a major concern. Much of the population, which is in lower income group, have per capita CO_2 emissions of about 335 kg, while a section of the population with the highest income group have per capita CO_2 emissions of about 1,500 kg. This was the summary of a recent survey report by Greenpeace under the title "Hiding Behind the Poor", wherein it was shown that in India the richest consumer classes produce 4.5 times more CO_2 (because of higher energy consumption) than the poorest class, and almost 3 times more than the average Indian (501 kg). Because of close linkage of CO_2 emission to energy usage, the societal impact of such inequitable energy consumption pattern is that, the poorest will be the most affected by the Global Warming, while the energy profligacy of the rich is the main cause for Global Warming. By removing such huge inequities through reduction in the energy profligacy of the rich, the legitimate overall demand for electricity can be reduced.

A December 2009 study report by title "Still Waiting" by Greenpeace indicates that while most of the additional installed capacity during the last 10 years has gone on to meet the escalating demand for electricity in urban areas, the rural communities continue to be denied with even the life line energy, even after 62 years of independence. This report also highlights that whereas the state capitals are getting between 23- 24 hours of electricity supply on an average, larger towns and cities are getting between 21- 23 hours of supply, villages are not getting even 12 hours of assured supply. It should be a matter of grave concern to a welfare society such as our that whereas the energy profligacy in Urban areas is escalating unabated in the form of air conditioners, AC shopping malls, electronic gadgets, night time sports, vulgar use of lighting for commercial advertisements, unscientific use of electricity for streetlights etc. the villages are not getting even life line energy.

Whereas the STATE continues to say that large addition to installed electricity generating capacity is essential to provide electricity to 100% rural households, a blatant discrimination exists where cities are registering continuous increase in per capita consumption of electricity, the rural areas are being continuously denied of electricity even for the basic applications such as lighting and drinking water. In this regard the insincerity of the STATE is obvious. The problem of Urban-Rural discrimination in electricity supply can be exemplified by author's own experience in rural India (Annexure 1).

If the energy profligacy in Urban India and by the rich is contained to the manageable level, the saved energy is likely to be so huge that 100 percent household electrification in villages may be achieved and life line energy for every house hold can be assured even with the existing generating capacity. Keeping in view the huge potential in distributed electricity sources such as roof top solar systems and community based bio-mass plants etc. and the efficiency improvement measures it is not inconceivable that through the existing techno-economically viable means it is feasible to drastically reduce the effective demand on the grid based electricity network. As per a study of the Karnataka power system in 2008 by the author the existing demand for electricity can be effectively reduced by as much as 50% by these measures ("Power sector reforms: a pilot study on Karnataka", http://www.indiaenvironmentportal.org.in).

The average Plant Load Factor (PLF) of thermal power stations in the country is reported to be about 78%, while the best run power plants of NTPC have PLF of above 90%. Some of the coal power plants in the eastern and north-eastern states are reported to be operating at less than 40% PLF. With about 93,000 MW of total installed thermal power capacity in the country, the increase in average PLF to 90% will save the need for about 11,000 MW of additional installed power capacity.

The technical losses in transmission and distribution of electricity can be reduced from the present level of about 30% to less than 10%, as has been demonstrated in certain pockets such as Bangalore city. This step alone can reduce the need for additional installed power capacity of about 15,000 – 20,000 MW at the national level.

The inefficiency in end use applications also is unacceptably high. As per a recent study report by Prayas Energy Group, Pune (*"Energy Savings Potential In Indian Households From Improved Appliance Efficiency")* usage of energy efficient models of common house hold appliances such as lamps, refrigerators, fans, TVs, radios etc. can result in about 30% energy savings in households annually by 2013. This corresponds to an avoided additional generating capacity of about 25,000 MW.

At the national level about 30% of all the electrical energy consumed is accounted for by the agricultural sector in the form of irrigation pump (IP) sets. In Karnataka this figure was about 38% in 2006. It is also an established fact that for various technical reasons the majority of these pump sets are so uneconomical/ inefficient that they are consuming about 40 to 50% more energy than really needed to perform the designated task *[Reference: Seminar proceedings on "Programme on Conservation of Energy in Agricultural Pumping Systems" (Sponsored by Ministry of Power, GOI) in June 1999, Central Institute For Rural Electrification, Hyderabad)]*. A quick estimate indicates that the loss reduction techniques (at an average cost of about Rs. 5,000 per set) can reduce the existing loss level from about 40% to about 10% providing huge savings each year. Such a measure is estimated to yield an additional virtual generation capacity of about 1,500 MW in Karnataka alone. Improving the overall efficiency of these pump-sets from the suction end to the delivery end at the national level will save a huge quantity of electrical energy of about 12 – 15% annually. Any amount of effective investment in this sector will be worthy of the cause, because not only the perpetual energy losses will be avoided, but will also result in all-round economic benefits like higher agricultural production and industrial production.

The potential to reduce the effective demand on the power system through IP sets is so huge that the Andhra Pradesh government was reported to have taken a decision few years ago to replace all old and inefficient agricultural pump sets by highly efficient sets at a budgeted cost of Rs. 15,000 crores. Since about 30% of the total energy consumed is in the agricultural sector, it also indicates the huge demand for electricity in the agricultural sector, which when reduced to international best practice levels can reduce the effective demand on the power system grid by a considerable margin. IEP has failed to identify such a vast virtual source of additional power. In other words the effective demand for electricity existing can be reduced by about 10-15% by improving the electricity consumption efficiency in agricultural sector alone.

In the current scenario, the huge potential to reduce the electricity demand for agricultural pumping through effective rainwater harvesting has also escaped the attention of IEP. With the ground water table getting continuously lower and lower, the energy required to pump water will continue to increase unless remedial measures are taken on a war footing. With effective and widespread rain water harvesting measures the electricity demand for water pumping for agricultural and domestic needs can be reduced considerably. The fact that agricultural pumping is accounting for about 30% of the total electricity consumed and that water is being lifted from a depth more than 500 feet in certain parts of the country must force our society to consider the rain water harvesting to reduce agricultural pumping

loads very seriously. Rain water harvesting can contribute too few other welfare measures such as; increased agricultural production, increased quality of drinking water, and water security.

IEP has fared badly in taking such a holistic approach to curtail effective electricity demand on the grid.

The huge potential to reduce the effective demand on the electricity grid network in India through efficiency improvement in appliances can be exemplified by one example of USA quoted in IEP document (IEP: Page 87). The specific consumption of electricity in refrigerators in USA came down from a level of 1,800 kWH per year in 1974 to a level of 476 kWH per year in 2001 (i.e 75% reduction) consequent to a series of measures including enforcement of efficiency standards. Bureau of Energy Efficiency under the Ministry of Power (MoP) estimates that the replacement of incandescent lamps by Compact Fluorescent Lamps (CFL) alone can save about 10,000 MW of additional power capacity.

In view of the growing pressure to reduce the GHG emissions to contain Global Warming, the central govt. has assured the international community that it will reduce the energy intensity of its economy by 20% by the year 2020. It is credible to expect a host of effective measures in this regard, which will reduce the energy demand in many areas of our economy in the years to come.

In view of the fact that that there is a steep decline in CAGR of electricity consumption from 6.87% in the 30-year period (between 1974-5 and 2004-05) to 4.30% in last 5-years (between 1999-2000 and 2004-05), and taking into account all the above mentioned factors, it is prudent to project only a 4 - 5% CAGR of electricity consumption for next 20-25 years. Assuming that the total installed capacity has to grow at the same rate, the total installed capacity in the country can be projected to be in the range of about 388,000 MW (for 4% CAGR) to 497,000 MW (5% CAGR) by 2031-32. This is in stark contrast to 778,000 MW (at 8% CAGR) as projected by IEP. With adequate emphasis on transferring most of the smaller loads such as lighting in domestic, commercial and streetlights etc. and appliances such as TV, computers, small water pumps etc. on to distributed renewable energy sources such as roof top solar PV panels, roof top solar/wind hybrids, community based bio-mass systems etc. the demand growth of the integrated grid can largely be contained within manageable limits in future.

The projection of 388,000 MW by 2031-32 is also consistent with the IEP's admission that the potential of DSM to reduce the effective demand is about 25%, and the fact that that there is huge potential in reducing the grid demand by effective deployment of distributed electricity sources such as roof top solar systems and community based bio-mass plants etc. in rural electrification. It is to be noted that IEP itself has discounted the Ministry of Power projection of 962,000 MW of installed capacity by 2031-32 on the premise that it is high.

Table 3: Projection of Installed Electricity Generating Capacity by 2031-32

Projection by	Unit	@ 4% CAGR	@ 5% CAGR	@ 8% CAGR	@ 9% CAGR	Comments
Ministry of Power	MW	-	-	962,000	1207,000	From a base of 140,000 MW in 2006
IEP	MW	-	-	778,000	960,000	From a base of 153,000 MW in 2006
Shadow IEP	MW	388,000	497,00	-	-	From a base of 140,000 MW in 2006

Going by our past record of actual annual growth in consumption, and the fact that energy intensity of our economy will keep going down for decades, the projection of demand growth at CAGR of 4-5% is reasonable. However, honest efforts must be made continuously to limit our peak electricity demand so as not to exceed 85-90 % of the total installed capacity.

In view of the huge deleterious impacts on our society of conventional technology energy sources such as coal based, dam based or nuclear based power projects all out efforts must be made to minimise the number of such power plants by containing the legitimate demand for electricity to a manageable level through all credible measures.

Unfortunately IEP has implicitly or explicitly adapted the GNP maximizing paradigm to estimate energy demand. In view of the many serious implications of unlimited energy demand as discussed in this section, there is rather an inevitable requirement to estimate objectively what is the least amount of energy needed to wipe out poverty, and how best to meet it in a sustainable manner. It is because of GNP maximizing paradigm that IEP has projected a huge demand for electricity.

There is no escaping the inevitability of the need to decouple our economic growth from increase in energy consumption.

3.0 Heavy reliance on coal power – compromising on sustainability

The most disappointing aspect of IEP is the absence of holistic approach to different aspects of various energy sources from a societal perspective. In general only the technical, financial and logistics issues seem to have been considered. Such a narrow approach cannot be the basis for a crucial national level policy.

As per IEP coal emerges as the most important energy source for India accounting for not less than 41% of our energy mix under any scenario and potentially reaching 54% of energy mix under certain scenarios by 2031-32 (IEP: Page 105). Even at the 41 % level, India will need 1.6 billion tons of coal annually by 2031-32, which is about 4 times the current production (IEP: page 71). In IEP's projection coal may represents 46% of all the commercial energy and 53% of the conventional energy sources for the scenario in 2031-32. The projected coal power capacity by 2031-32 is about 320,000 MW including coal bed Methane and in-situ coal gas (IEP: Table 3.9, page 46). The second column in table 3.9 of IEP indicates only a total installed capacity of 700,703 MW. Whereas the total installed capacity in 2031-32 as per IEP should be 778,000 MW, this figure of 700,703 MW leaves a gap of about 78,000 MW, which can be assumed to come from coal power. Hence the total coal power capacity by 2031-32 as per IEP projection can be assumed to be about 400,000 MW. This means an increase of about 5 times over 80,000 MW installed coal power capacity at present. Such a massive increase in coal requirement will pose huge problems to the society as a whole.

A fundamental issue associated with coal based power policy seems to have been ignored by IEP. Whereas coal power plants are base load power plants, requiring power production at maximum level to be economical, the demand projection in different regions of the country indicate that the deficits are more during peak demand hours than the annual requirement of energy. Hence building large coal based power capacity may not exactly fit the power scenario in all states/regions. A simulation study by D.

Narasimha Rao, Visiting Faculty, IIM Bangalore in May 2006 for the state of Karnataka has revealed that building a number of coal based power plants, as proposed in Karnataka at that time, would result in excess base generation capacity by year 2015, and is likely to result in overall thermal PLF of less than 35%. Such a low PLF will not only be disastrous economically but clearly will not be in the interest of the society. With changing electricity consumption pattern, the focus on peak demand management, and increased awareness of GHG emissions etc., adequate care is needed to ensure that unnecessarily excess base generation capacity will not result in any state/region. There may be arguments that if one state is surplus in base generation capacity, the excess can be exported to the grid. In this context a question needs to be asked whether it is worth setting up excess coal power capacity, at great societal cost to a given state, only to export excess power to another state. It is not clear from IEP report whether such a situation has been considered carefully.

Whereas a predominant role for coal has been envisaged during next two decades in the country, and possibly beyond, the deleterious impacts on our society of mining and burning such huge quantities of coal is not at all discussed in IEP. The largest user of coal, NTPC Ltd, has been complaining for a number of years that coal supplies to its thermal power plants were inadequate. About a year ago, the minister of State for Coal is reported to have said. "There are no two opinions about the need to switch over to other modes of power generation ……. Coal-based power production has to be restricted". Coal ministry officials claim that the demand and supply of coal to the power plants was going to run neck to neck in times to come. This only indicates the seriousness of the problem of reliable coal supply even for the existing power plants.

India at present has approximately 75 coal-based thermal power plants, out of which 72 are known to be catered to by Coal India Limited (CIL). With about 96% power coal supply responsibility with just one state owned public enterprise, it is anybody's guess how the reliability of coal supply is likely to be if our coal power capacity is to be increased by 4 times. The railways are already struggling to carry coal to power stations on a reliable basis. If the proposed target were to be realized it is difficult to imagine the chaos in the transport sector to move coal from one part of the country/ port to the power generation sites. As indicated by the IEP even if 15 to 20% of the total quantity of coal required to support such a huge installed capacity by 2031-32 is to come from overseas, the need to set up additional port facilities, environmental impacts of the same and the stress on the road/rail infrastructure to carry the coal from these ports will be huge, which have not been discussed at all in IEP.

IEP has admitted that the coal reserve in the country is not huge as was thought few years ago. It says that if the domestic coal production continues to grow at 5% per year, all the total extractable coal reserves (including proven, indicated and inferred) will run out in about 45 years (IEP: page 34). As a policy document IEP has failed in taking a longer term view of considering what would happen to energy security for the country after 45 years if we continue to relay so heavily on coal; because there are no clear recommendations to find a substitute for coal by the time when we run out of coal.

A recent announcement by Environment Ministry (MoEF) has indicated that about 33% of all coal reserves in the country are below very thick forests, and hence will be 'NO GO' areas for mining. In this context it is not clear as to how large quantity of additional coal supply can be ensured. In a clear admission of the natural limit to conventional coal mining, IEP has discussed few other coal related options such as coal bed methane, in-situ coal gasification and coal liquefaction, but also recognizes that these technologies are still in nascent stage.

The social, economic and environmental aspects of a coal based power policy are enormous for a country such as India with densely populated communities and limited natural resources. As per a report (from Down To Earth magazine; Dec. 12, 2008, Annexure 9) Indian coal power plants demand large tracts of land (about 0.4 hectare per MW of capacity due to low calorific value of coal) and huge quantities of fresh water (about 80 Cubic meters per 1,000 KWH of energy production while the global best practice is just 10 cubic m/1,000 KWH). They burn enormous quantity of coal (about 0.7 kg per kWH) and generate mountains of ash (about 30 % of ash content in Indian coal). As per this report from Down To Earth magazine, in 2005-06 the state owned coal power stations were estimated to have generated about 113 million tons of fly ash, 1 million tons of particulate matter, 347 million tons of CO_2, 19 million tons of Sulphur di-oxide and tons of mercury and NOx & other flue gases. Such a high level of pollution invariably leads to serious health problems, affects agricultural production, and threatens the livelihood for the local communities. Despite many recommendations in the recent past to minimise these pollutants the overall impact of these pollutants on our society has only increased as per official reports. But IEP has chosen to be silent on these issues of both local and global importance.

Advocates of coal power often argue that the environmental issues of coal burning can be contained by clean coal technologies, which are emerging. The reality behind such claims is mentioned in Annexure 2. It becomes obvious that the environmental issues of coal burning can only be reduced to some extent, but pollutants and other related issues will continue to haunt us.

The coal power lobbies resort to frequent comparison in this regard with China, which is known to have added a lot of coal power capacity during a short span of 10 -15 years. International reports indicate that in China on an average one coal based power unit was commissioned every 15 days from Year 2000 onwards. A comparison of the environmental disaster that is facing China because of its coal power policy is worth noticing. With so much of coal power having been added in such a short period there is no escaping the colossal pollution because the carrying capacity of the nature there seems to have been exceeded. No surprise, hence, that China is considered the second biggest polluter in the world. The atmospheric pollution there seem to be so heavy that a survey has revealed that about 50% of the rivers covered in the survey were found to be unfit for drinking. So much so that when Beijing won the rights to host 2008 Olympics it had to undertake massive clean up operation in and around Beijing to make the air acceptable for breathing easily. As a part of this clean up drive on an average one old coal power unit was reported to have been decommissioned every month. According to World Bank estimates China is also fast becoming an ecological wasteland, home to world-class smog, acid rain, polluted rivers and lakes, and deforestation. Environmental problems are reported to play a major role in the death of some 300,000 Chinese people each year. The massive impacts of such huge additions in a short while on Chinese society are described by a Business Week report in August 2005 as in Annexure 3.

Ignoring these far reaching consequences IEP says (IEP: page 47): "A massive effort is clearly required to expand domestic coal production". Even though the high ash content and the low calorific value of domestic coal have been mentioned in the report, the projection still recommends massive increase in coal power capacity. If the coal power capacity were to increase 5 times by 2031-32 as per IEP projections, it is realistic to assume that the pollutants and other concerns as listed in the table 4 also will increase at least by 4.5 times, if we allow for efficiency improvements in pollution reduction measures. The social, health and environmental impacts of such a large increase in coal power capacity will be colossal. By not dealing with these critical issues IEP has failed in its duty of care, which was to come up with a credible energy policy leading to all round welfare of masses.

The IEP projects the requirement of coal for power generation to increase from 406 Mt in 2004–05 to 2555 Mt in 2031–32. Since the domestic supply of coal is limited, IEP projects that upto 45% of the coal requirement in 2031-32 would need to be imported (IEP: Page 45-46). The problem is: globally available exportable coal supplies are also running out! A recent study by the Energy Watch Group of Germany predicts that global coal production will increase over the next few years, peak around 2025 and then decline. Clearly then, it is foolhardy to base our future energy security on a resource whose domestic supplies are declining and the global availability of which in adequate quantities beyond 2030 is suspect.

Table 4: Major issues with coal based power policy

Economic	Puts huge pressure on natural resources such as land, water and minerals; demands a lot of construction materials like cement, steel, sand; will increase average cost of power; road and rail transportation infrastructures need a lot more strengthening; pressure on ports will increase due to the need for import of coal; land costs around coal power projects will become unaffordable to locals; overall efficiency from coal energy to end use of electrical energy is very poor of the order of about 10% only.
Social	Peoples' displacement will cause additional unemployment & increase in slums; will affect agricultural production and health; prospect of displacement will create social tensions and stiff opposition; local buildings of heritage importance will degenerate; nearby places of tourist and religious importance loose prominence; causes serious erosion of local community development; livelihood and drinking water needs of the local communities will be threatened.
Environmental	Safe use for all the ash generated is not available yet; acid rain will affect flora and fauna including forests and agricultural crops; coastal power plants will affect marine creatures; destruction of forest lands to open more of coal mines; have to contend with nuclear radiation in coal ash; credible threat to bio-diversity; fresh water sources will be polluted; reduces the access to fresh water sources near mines; huge contribution to Global Warming and Climate Change; negates the purpose of National action Plan an Climate Change.

While the projection of 5 times increase in coal power capacity by 2031-32 gives rise to huge socio-ecological concerns, the gross inefficiency associated with the coal energy chain itself is shocking. Whereas the thermal efficiency of coal fired boilers, to convert coal energy to steam energy, is in the range of 30-32% in India, the best technology available can take it to a maximum of about 40% as per IEP (Page 86). With station auxiliary consumption of about 7-9% for Indian coal power stations, transmission and distribution (T&D) loss of about 30%, and huge inefficiency in end use applications, the overall efficiency of coal energy to productive/economic end use can be only about 10% as per many international reports. This is in stark contrast to 12 -15% efficiency of solar photo voltaic (SPV) panels in commercial use in the country. It is also reported that 20-25% efficiency of SPVs has already been achieved in laboratory conditions using new materials. In this regard IEP has ignored the apparent benefits of solar PV panels as compared to coal power, especially in view of the huge socio-ecological costs of coal power.

IEP does not appear to have devoted any time to deliberate on such crucial issues. Without satisfactorily addressing these issues it is not clear how public's support can be expected for this policy. An obvious result of such a coal based power policy for the country is that the states seem to be in a great hurry to build large number of coal power plants either in State sector or private sector without objectively considering the long term impacts of such additions. The liberalisation regime, needing no license but

only few clearances, such as environmental clearance to build a coal power plant, has become a catalyst for large number of coal power plants mushrooming all over the country.

IEP seem to encourage even those states with no coal reserve to opt for coal power plants. Many states like Karnataka and Kerala, which have no coal reserve and which are also facing acute crises in fresh water supply, are on an overdrive mode to set up coal power plants within their states without objectively considering any of these issues. Even the Himalayan state of Himachal Pradesh is also reported to be planning to build a coal power station.

Classical power plant economics indicate that a coal power plant is optimally economical if it is located either at coal pit head or close to the electrical load centre. But due to sheer absence of a rational approach many coal power plants are coming up at places far away from these locations and even at places not suitable for coal power plants. Even ecologically sensitive places such as river estuaries, sensitive coastal areas, and vicinity of bio-diversity hotspots such as Western Ghats are being considered to locate such high polluting power plants. Examples of such callous decisions are the Ultra Mega Power Projects (UMPP) proposed near Tadadi, in Karnataka, and Girye in Maharastra, both on coasts, near estuaries and in the close vicinity of Western Ghats. A large number of coal power plants are already in various stages of planning/implementation/ operation in such sensitive areas such as east and west coasts. Such irrational decisions are resulting in great burden to the society in the form of unacceptable magnitude of social and environmental costs. In a statement which may indicate the gross neglect of the social and environmental aspects of large coal power plants on coastal regions IEP makes a statement: "Unfortunately coal consumption at coastal sites is currently minimal" (IEP: page 12). As though taking cue from this statement a large number of power plants is being proposed /built all over the east and west cost of the country. More than 18,000 MW of capacity in Andhra Pradesh coast and more than 25,000 MW in Maharastra coast are reportedly being implemented. Naturally, a huge groundswell of opposition to these projects is reported.

As per a notification of the Ministry of Coal in February 2009, 63 applications from State Electricity Boards, 234 applications from independent power producers (IPP), 180 applications from Captive Power Plants were pending as on 2nd February 2009 for coal linkages for power plants of various sizes. These are huge numbers, and will escalate in the years to come unless urgent course corrections are applied. Our society's proven inability in identifying and appreciating the strict norms for pollution control, and wanton incompetency in enforcing even the modest conditions of license has meant that the deleterious impacts of such a large number of polluting power plants has the potential to devastate our way of life.

While planning for future power generating capacity expansion all these issues must be taken into objective account. It is a well-known fact that none of the past 5 year plans, including the present one, have achieved the target capacity addition. The popular opposition to large size coal power projects are growing to such an extent that many project proposals are being cancelled. Two such recent examples are the Ultra Mega Power Projects (UMPP) near Tadadi, in Karnataka, and Girye in Maharastra which were cancelled due to popular opposition. In recent years due to active involvement of NGOs in protecting the rights of the locals and of bio-diversity, the opposition to large size coal power projects has become a common factor because of the issues such as adequate compensation, threat to livelihood, cultivable land, fresh water, agricultural crop loss, and health problems are being adequately highlighted. Most of such oppositions are being taken to the court of

law, where the judiciary has started taking serious note of social injustice and environmental degradation. Whereas IEP has just mentioned that some of these issues have to be sorted out, no discussions have been done to recommend credible remedies.

Few major issues of concern to our thickly populated society, which cannot be ignored at all, are: the issues of land acquisition, diversion of fresh water for coal power plants, impact on agricultural production, and health issues associated with coal burning. IEP has not even adequately referred to these issues, whereas it claims to address the issue of energy security in order to ensure poverty eradication and human development goals.

It is evident that for the densely populated communities in our country these issues have much higher priority than the assurance of electricity supply, which, anyway, has never been kept in the past.

A feeble attempt seems to have been made in IEP to address the environmental impacts of coal power plants by advocating clean coal technology. The commonly known understanding of clean coal technology is that the GHG emissions from such a technology will be less than the conventional technology, but the GHG emissions and pollutants cannot be completely eliminated. Literature search on clean coal technology indicates that it is an umbrella term used to describe technologies being developed that aim to reduce the environmental impact of coal energy generation. It implies that it is possible to make coal a fuel source that is free of (or very low in) carbon dioxide emissions and other pollutant emissions, many pollutants will remain a source of major concerns. The additional energy requirements of Carbon Capture and Storage (CCS) or Carbon sequestration itself is estimated to be about 33% of the associated plant capacity, and also is expected to cost considerably, probably to make the coal power unviable.

Even if Clean Coal Technology turns out to be techno-economically viable in few years time, there is no escaping the fact that atmospheric pollutants will not be completely eliminated from the coal burning process, and the total GHG emissions from a large number of additional coal power plants will be much larger than the avoided emissions from Clean Coal Technology.

A less known report from USA states that the coal-fired power plants throughout the world are the major sources of radioactive materials released to the environment, and that there are several serious implications of such radioactive emissions. This report with the title "Coal Combustion: Nuclear Resource or Danger" by Alex Gabbard suggests that coal combustion is more hazardous to health than nuclear power, and that it adds to the background radiation burden even more than that by nuclear power. It also suggests that if radiation emissions from coal plants were regulated, their capital and operating costs would increase, making coal-fired power less economically competitive. The authors of the report concluded that Americans living near coal-fired power plants are exposed to higher radiation doses than those living near nuclear power plants that meet government regulations. A similar scenario in Indian conditions and serious ramifications of it are not inconceivable. While the society needs to ensure adequate safety precautions in this regard, it is very unfortunate that IEP has not even mentioned the possibility of background radiation burden from coal burning in the country.

An authentic report on the major health effects of massive coal burning is a report of 2009 by the title "Coal's Assault on Human Health" by Physicians for Social Responsibility. This report refers to coal combustion emissions such as sulfur dioxide, particulate matter (PM), nitrogen oxides, mercury, and dozens of other hazardous substances, which damage the respiratory, cardiovascular and nervous systems of the human body. In particular, these emissions contribute to some of the most widespread diseases, including asthma, heart disease, stroke, and lung cancer (Annexure 4).

If a large country like USA with much large land area and resources, but with much less population is so much concerned about the health effects of coal burning, the much more constrained society like ours must seriously consider the pros and cons of coal based power policy.

An argument being offered by the proponents of coal power is that it contributes to energy access for the poor people and the rural areas. The fact that a massive increase in coal power capacity in the country since independence has not enabled 40% of the population to have access to electricity even in 2010 negates such an argument. A new report by Oil Change International, released on the eve of the World Bank's Annual Meetings, dispels the myth that World Bank support for coal and oil projects increases access to energy for the world's poorest. The World Bank has used arguments around increasing energy access – providing energy to the 1.4 billion people who lack access to electricity or the 2.7 billion still using wood or biomass for cooking and heating – to justify the approval of massive new coal-fired power plants like the Eskom plant in South Africa, as well as the continued funding of oil projects. But both Oil Change International's original research and the Bank's own analysis show that none of the Bank's coal or oil lending for the last two years have prioritized increasing energy access (Annexure 4A).

In view of the fact that coal power plants contribute substantial portion of Green House Gas (GHG) emissions the international scientific community such as Inter Governmental Panel on Climate Change (IPCC) are unanimous that the emissions from coal power plants have to be minimised at the earliest, which means minimising the number of coal power plants instead of increasing them. IEP has completely ignored even such scientific reasoning.

4.0 Large hydel power capacity addition: is it really green and renewable?

IEP envisages large role for hydel power as far as installed capacity is concerned. It identifies a total hydel power capacity of 84,000 MW at 60% load factor in the country, but projects that planning should be done for 150,000 MW capacity at a much lower load factor of about 30% by the year 2031-32 (IEP: page 36 and table 3.5). This massive increase in hydel capacity of about 4 times (from the present capacity of about 37,000 MW) in 25 years will pose huge socio-environmental problems, which unfortunately have not been discussed in any detail.

If we consider the fact that it has taken more than 100 years to commission about 37, 000 MW of hydel power in the country, it would be very hard to imagine how the capacity can be increased to 150,000 MW capacity in the next 25 years. The issues such as submersion of fertile agricultural and/ or thick forest lands in the dam waters, displacement & resettlement of project affected families, massive impact on river ecology and aquatic creatures, methane emission, socio-economic

issues associated with reduced flow in the river etc. are all so complex and acute that every hydel project is being sternly opposed by the local communities and environmentalists.

Neither the report of the World Commission on Dams, 2000, nor the report by International Commission on Large Dams (ICOLD) has been in blind support of large dams. Both of these reports have strongly advised extreme caution and thorough consultations with all the stake holders before taking a decision to build dams. Our own past history of not demonstrating adequate responsibility in correct planning, execution, rehabilitation, reporting etc. has resulted in strong opposition against any future dams. The judiciary has also been taking a keen interest in upholding such popular opposition to any hydel project which would further reduce our forest cover and displace communities.

Where as the Narmada Valley hydel projects are going ahead despite massive opposition many other projects such as Silent Valley project in Kerala, Bedthi project in Karnataka, few recent projects in Uttarakhand and Sikkim have been cancelled due to massive opposition by the locals. Proposals for Gundia hydel project in Karnataka and Athirapally hydel project in Kerala appear to be certain to be denied clearance because of massive opposition to these projects on social and environmental grounds. Many other hydel project proposals in Uttarakhand, Sikkim, Manipur and Arunachal Pradesh are being opposed strongly on various grounds, mostly on socio-environmental grounds. The past and present oppositions to hydel projects have not been considered in IEP while proposing a large addition to hydel capacity.

IEP's projection of 150,000 MW hydel capacity at a low load factor of about 30% by the year 2031-32 throws up many issues. 30% load factor basically means that on an average the power station capacity is designed to be used only for 30% of the time. While horrendous amounts of resources including land, buildings, machinery, transmission lines, hydraulic structures, roads etc. will be used up to build such a large capacity at huge costs to the society, the electricity is expected to be generated for a small period in a year with assets expected to be idle for 70% of the time. This is in stark comparison to 50-60% load factor generally associated with a large dam based hydel power project. But there are serious issues of optimal usage of our resources in the case of existing hydel power plants designed for higher load factors.

The dam building activity has been known to transform the landscape, ecology and economy of the region, and also to have far reaching consequences all the way to the river deltas such as SunderBans in case of river Ganga.

Some of the major economic issues associated closely with dam based hydel projects, which the IEP has ignored to factor in are:

- Submergence of lands, agricultural fields, forests, grazing lands and homes on a large scale can lead to the displacement of a large number of people. This in turn can threaten the very livelihoods for the Project Affected Families (PAFs).

Table 5: Major issues for the society with hydel power projects

Economic Issues	Demands large tracts of forest and fertile agricultural land; water logging affects the economy of down stream population; denial of silt affects the agriculture downstream; threat of localized earthquake due to impoundment of water; local economy will suffer due to isolation because of land submersion.
Social Issues	Peoples' displacement and Health; isolation of affected communities; compensation issues will create social tensions and stiff opposition; local buildings of heritage importance will degenerate; nearby places of tourist and religious importance may get drowned; causes serious erosion of local communities; livelihood issues; gradual death of local villages; safety of dams in Himalayas due to glacial lake outburst is a serious issue to contend with.
Environmental Issues	Submersion and fragmentation of forests; loss of bio-diversity; Methane emission; downstream areas get deprived of fertile silt; local pollution due to construction materials; threat to aquatic creatures in downstream

- The compensation that may be admissible to such people is generally considered to be inadequate to enable them to lead a satisfactory life, as has been the recent past experiences. In any project there will be a substantial percentage of local population, who may not have legal rights to the land, but are heavily dependent on the local natural resources such as land, river and forests. Our society's inability, as has been recorded in the past, to undertake and ensure comprehensive rehabilitation of such PAFs has turned out to be a major economic disaster because many of PAFs who have lead a satisfactory life in a traditional system, have become destitute after displacement; some of them have been subjected to multiple displacements.
- Disruption to downstream flows will have impact on agriculture and fisheries threatening the livelihoods of people, who have no other employment skills to depend on.
- Sedimentation has been a major issue with Himalayan dams. Reports indicate that the sedimentation rates are the highest in Himalayan rivers amongst all the Indian rivers. A dam designed for a life of 50 + years may become fully silted in about 30 years if adequate measures are not taken to (i) reduce silts from the slopes of river valleys, and (ii) allow the majority of silt to pass through the dams.
- Construction of dams are preceded by clearing of trees, excavation, fragmentation of the forests, dumping of debris/ construction materials, noise and air pollution due to construction activities etc. These would lead to the degradation of natural surroundings, and to degraded water sources.
- Impounding of water in the dams is known to cut off access roads thus isolating villages/ communities. This has adverse effect on the economy of the locals.
- The cumulative impact of a number of dams in one region, or as a cascade of dams on one river is much higher as compared to the impact of a single dam.
- Himalayan region has been known to be seismically very sensitive, and hence dams in these regions face potential risk of catastrophic failures from earthquakes.
- Another area of concern for building dams in Himalayas is the threat due to Global Warming. With the accelerated glacial melting the dams are likely to see huge increase in inflows initially and then highly reduced inflows in subsequent decades. This effect is likely to threaten the safety and economy of the dams.
- Additionally, the floods caused by Glacial Lake Outbursts, which are fairly common to Himalayan region can threaten the safety of dams.

- The people who will benefit most by the proposed large number of hydel projects are the project developers, but the consumers and the local people will face all the hydrological risks and economic difficulties.
- The vastly reduced amounts of silts in rivers obstructed by dams would have serious impact on the nature and area of river deltas. They are known to have resulted in ingress of sea inlands affecting the water quality. There are reports that in Gangetic delta such erosions have resulted in considerable reduction in the size of delta, and hence there can be an issue of territorial integrity.
- While the proponents of dam based power projects would like to call them green energy options, the huge potential of GHG emissions from the submerged vegetation in the reservoir behind dams have been conveniently ignored. Such submerged vegetation emits Methane gas which is about much more potent than CO_2.

As per a study by Himamshu Thakkar of South Asian Network for Dams, Rivers, and People (SANDRP), out of 228 operational hydel projects in India as on 31.3.2007, which were surveyed by him, 82% were underperforming with actual generation of electricity which was less than 50% of the design capacity. This situation is mostly due to overestimation of the hydro electricity potential of the individual projects or sedimentation or both. Sharavathy valley hydel project, which is a major project in Karnataka, is known to have recorded full reservoir level of stored water only in 4 years out of 30 years after commissioning. Such overestimation of the hydro potential has resulted in many projects acquiring more forest /agricultural lands than required, and consequently has displaced more people than was really necessary.

The study by Himamshu Thakkar also reveals that between 1995 and 2007 the electricity generation from the hydel power projects in the country has come down from 3.97 GWH per MW to 3.39 GWH per MW despite the fact that year 2007 saw a rainfall which was 105% of the long term average. This indicates gradual decline in the outcome of hydel projects, probably due to silt accumulation and other factors.

A major casualty of dam based power policy is the huge loss of bio-diversity in the form of forest wealth, loss of river based aquatic life, loss of agricultural /horticultural crops, loss of medicinal/herbal plants etc. It is very unfortunate that IEP has not considered the burden on our society in the form of economic and ecological cost of loosing these natural resources when advocating the full exploitation of hydro potential in the country.

A huge deficiency in the river management policy of the country is the absence of any legal mandate to maintain a minimum flow in a river either with or without dams. This minimum flow called as ecological flow is considered crucial for sustenance of aquatic creatures of the river and other flora and fauna dependent on the river. Without such a mandate some of the rivers have already become inconsequential, and many more are expected to go dry in the near future. No explanation will be needed to understand the impact of such reduced flow in rivers on the livelihood of people. Dams will contribute hugely to such reduced river flows either in small stretches or at the estuaries.

Another major issue with dams is that the quantity, quality and pattern of water flow in the rivers get heavily impacted with the result that biodiversity dependent on river flow is severely affected. At the global scale the value of ecological functions as well as resources of the environment (both terrestrial and aquatic) has been estimated to be about $33 trillion per year, which is almost twice the global

domestic product. Fresh water ecosystems are considered to be ecologically more valuable than the terrestrial ones. Even if we consider that this value is equal to the GDP of our country, the losses to the society by building so many hydel power plants will be immense. In this context IEP has completely ignored even the economic implications of loosing the wealth of the bio-diversity lost/impacted by hydel projects.

In view of the multifarious costs to the society of dam based power projects, the real benefit to the society has to be objectively analysed. There are many case studies wherein high level costs and benefits have indicated that in most cases of dam based power projects the total of all the direct and indirect costs to the society is much higher than the benefits. It should be noted that most of the benefits will accrue to the project developer whereas the costs are incurred by the larger society.

In a detailed study of costs and benefits of Kotlibhel 1B hydel project in Uttarakhand, Dr. Bharath Jhunjhunwala has meticulously listed a large number of costs to the society, which are never taken into account by Indian authorities. He shows that the total benefit and cost of Kotlibhel 1B HEP in this CBA are calculated as Rs.155.5 Crores, and Rs.931.8 Crores respectively, because of which the resultant economic value of the project can be a net loss of Rs. 776.3 Crores to Uttarakhand and the country (Annexure 5).

Because of another such study by a group of scientists the 210 MW hydel project proposal, proposed across river Bedthi in Karnataka, was shelved on the ground that the economic value of the biomass generated by the local forest identified for submergence by the dam waters was more than the energy equivalent of the proposed project (Annexure 6).

As a welfare society, needing concerted efforts to lift a substantial section of our population from the clutches of poverty, we cannot afford to ignore these externalities to dam based power projects.

The large number of hydro-electric power plants proposed under IEP must be subjected to rigorous analysis of all the costs and benefits (CBA) not only to an individual state but also to the region and the country. In the context of Global Warming and Climate Change, which are being viewed by scientific community with ever increasing concerns, the impact on bio-diversity and erosion of forest wealth and consequent emission of Methane (CH_4) in such CBAs has regional and global significance too. Additionally, there is a need to decide whether the revenue from the hydel projects is worth accepting the adverse impact on economic, social, and environmental issues on the region and the country. This particular issue is of special significance because most of the additional hydro power potential is considered in Himalyan and North Easter States, where the electricity demand of each state will not need the construction of so many additional power plants. Many Himalyan and North Easter States are reported to be planning to build a number of hydel projects basically to earn net revenue to the states. This policy needs a holistic review.

A financial analysis done on West Seti hydel project in Nepal, which is basically meant to export the energy generated to India, indicates that net revenue to the local economy will be very meager after allowing for the capital investment recovery and profits of the private investors. This has particular relevance to Himalayan states, which may view a large number of hydel projects as revenue earning mechanism by exporting generated electricity to other states.

(Source: Mountains of Concrete – Dam building in the Himalayas by Shripad Dharmadhikari)

Some of the arguments offered by IEP to project 150,000 MW of hydel power by 2031-32 are:

- that hydel power is renewable and green power,
- that it will provide the much needed peak hour demand support,
- that it will provide the much needed water security through storage facility.

Because of the emission of Methane as a GHG and drowning of large tracts of forest lands hydel power cannot be considered green in its real sense. Since the dam, power plant and the associated structures have to be abandoned/decommissioned after the useful life of about 50 years it cannot be termed as renewable either.

Though the flexibility of starting and stopping hydel power quickly is beneficial from the operational perspective of the electricity network, in view of the huge impacts on the society of such projects it becomes essential to analyse whether such a facility is essential. There are many power systems, much larger than that of Indian power system with predominantly non-hydro power, which are functioning satisfactorily for decades. Examples are the power systems in France and UK. As long as we can keep the gap between peak hour demand and average demand in a day within the limits of the total thermal power capacity of the system there is really no need to have a large hydel power base as suggested by IEP. And there are viable means of reducing the peak hour demand.

IEP advocates more of large size dam based hydel projects on the premise that such dams will assist in water security also. For some strange reasons IEP has ignored the huge potential associated with rain water harvesting not only to provide much higher water security but also to reduce the demand for electricity in water pumping needs.

The concept of large dams for the sake of water security is being strongly questioned all over the world. The official project reports [detailed project report (DPR)] are known to ignore the true cost of decommissioning of dams, once their economic life comes to an end. These costs when taken into objective account can have a major impact on the cost V/S benefit ratio of the project itself. In a recent book by title "Economics of River Flows" Dr. Bharat Jhunjhunwala has addressed the topic in the background of such experiences in USA. He has shown that the economics of dam building are being seriously analysed on credible grounds in USA, because of which many dams are being decommissioned, and which should forewarn our society of the costly experiments we may be undertaking in building a large number of dams. There are also credible arguments that dams can be source of floods instead of the traditional view of flood controllers.

IEP seem to favour a large addition to hydel capacity on the premise that most of the additional capacity projected by 2031-32 should come from small size power projects of unit/plant size of 25 MW. In this regard we have to consider the fact that small hydro have the same negative impacts as big hydro. The negative impacts are less but power generation per project is also less. The Cost-Benefit Analysis would be identical. However, the negative impacts could be reduced by stipulating that only partial obstruction to flow of water will be made and other similar strategies. Until this is clearly stated, small hydro cannot be termed as clean.

Without taking the following issues into objective account, the real cost of dams to the society will be hidden:

- Comprehensive rehabilitation, which among other things shall mean rehabilitating the displaced people enabling them to lead the same or better quality of life on a sustained basis;
- In addition to the comprehensive rehabilitation of the people with official land rights, the rehabilitation of all others, including the laborers, hunters, gatherers etc. who have been living in that area should also be taken up;
- Respecting the right to exist for the fauna, and protecting the endangered species of flora;
- In the case of a dam, the impact of water logging on the adjacent agricultural areas, and the likelihood of water borne diseases;
- Opening up the forests to outsiders with little respect for the local environment resulting in large scale illegal felling of trees and poaching;
- Welfare of the locals who would find themselves in marooned villages because low lying areas would have been submerged; socio-economic impact on the locals etc;
- Reduced localized rainfall because of the reduced forest cover etc.
- Loss of medicinal herbs, and thus the livelihood of the gatherers of these herbs.

According 2002 Central Water Commission Register of dams, India had 4,525 large dams (which are over 15 meters tall) including 475 under construction dams. As per a report by Ivan B.T. Lima et.al (2007): "Methane Emissions From Large Dams as Renewable Energy Sources " large dams in India are responsible for about 20% of the country's total global warming impact in the form of Methane, CO_2 and Nitrous Oxide. This study report, by Brazil's National Institute for Space Research (INPE), also estimates that Indian dams are the largest global warming contributors compared to all other nations. These latest round of studies should help shatter the myth that power from large hydropower projects is clean.

One of the arguments offered by the proponents of dam based hydro power is that it provides safety against floods. This argument has a weak basis looking at the annual floods we have been experiencing on the downstream of dams in Yamuna, Krishna, Godavari, Kosi, Cauvery etc. Recently Ganga river also has caused massive flooding despite the Tehri dam in Uttranchal. One cannot forget the disaster due to Morvi dam in Gujarath few years ago, and the recent flood damages in Surath. Additionally, the huge impact on the river delta due to multiple dams has been conveniently overlooked by such proponents. A news report in Hindu of 7 Oct. 2010 has vividly described how a series of dams across river Indus in Pakistan has failed to prevent massive floods, and also how such floods are welcomed by the people at the river mouth because of massive ecological benefits of floods (Annexure 6A).

Few major social issues associated in impounding water in large reservoirs are (Reference: Mountains of Concrete – Dam building in the Himalayas by Shripad Dharmadhikari):

- The river valleys in India have been human habitats with social, cultural, religious and heritage importance for thousands of years. Many of the old temples and other religious institutions, which have been a source of spiritual inspiration for centuries, may face permanent destruction from dams.
- Probably the most affected community from dams is the tribal community, who live in isolated places in a small number with distinct identity, language and culture. The influx of migrant workers from other parts of the country for construction can devastate their community life.
- Tribal populations normally have close ties with rivers, forests, hillocks and animals. With submergence of their sacred elements they will undergo extreme deprivation.

- Large influx of migrant workers from other parts of the country to be engaged in dam building activities will put the local communities under severe pressure due to social and economic issues: competition for natural resources such as land and water; increase in price and shortage in availability of construction materials; pressure on language and culture etc.
- A large number of people in rural areas depend a lot on the rivers and streams. Hourly, daily and seasonal change in the river flow, due to the construction of dams, will impact them massively. Sharavathy tail race project in Karnataka is a glaring example. Being the fourth hydro electric project on the river Sharavathy, conditional approval was given to run it as a run-of-river scheme, but it has been operating as a peak load station severely affecting the ability of the downstream people to cope up with the sudden gushing of water during the peak hours of the day. Another example is that of Narmada valley project where a number of people were reported to have been washed away due to sudden discharge of water from one of the reservoirs.
- Such vulnerable sections of our society, who may not have any other professional skills, will struggle to earn their livelihood when they are displaced from their natural habitats.

Despite repeated cautionary advises from a number of related reports both from domestic and international communities, our policy makers have continued to fail to take necessary measures while building hydel power projects causing incalculable losses to our communities. Our society can ill-afford to continue with this irresponsible attitude towards the long term welfare of our communities.

Our society's inability to effectively rehabilitate the project affected families (PAFs) should have been a major consideration for IEP. Sadly the same has not even been discussed. A renowned social activist Arundhati Roy has associated the growth of slums in Jabbalpur to the increase in height of Sardar Sarovar Dam. Narmada Bachao Andolan under the leadership of Medha Patkar has been highlighting serious mistakes by the concerned authorities for a number of years. Dr G D Agrawal's recent fasting to protest against many hydel projects in Uttarakhand has focused on many crucial issues. As a welfare society we cannot afford to ignore such societal concerns. A development process such as building a power project should not put a section of the society to such deprivations.

Taking all these issues into objective account it becomes evident that the recommendation to increase the hydel capacity in the country from the present level of about 37,000 MW to 150,000 MW by 2031-32 should be thoroughly reviewed keeping in view the long term welfare of the society.

5.0 Large addition to nuclear power – how relevant and green is nuclear power?

IEP admits that India is poorly endowed with Uranium, and that the known sources within the country can supply only about 10,000 MW of power capacity based on Pressurised Heavy Water Reactor (PHWR). It also say that because of low grade Uranium ore available in the country, Indian nuclear fuel costs at least 3 times that of international supplies (IEP: Page 74). It adds that the substantial Thorium reserve in the country should be harnessed by converting it into fissile material through three stage development: PHWRs, fast Breeder Reactors (FBRs), and reactors based on Uranium -233 and Thorium -232 cycle, which is still reported to be far away from reality. Yet IEP advocates a large and unrealistic addition to nuclear power capacity by 2031-32.

Observers of nuclear power industry have been of the opinion that whereas the nuclear establishment in the country has been making tall claims on the increased role of nuclear energy, the reality has been much less in successive decades after independence. On the basis of many plans and assuming optimistic development times, Dr. Homi Bhabha had announced that there would be 8,000 MW of nuclear power in the country by 1980. As the years progressed, these predictions increased. By 1962, the prediction was that nuclear energy would generate 20,000 -25,000 MW by 1987 and by 1969 the AEC predicted that by 2000 there would be 43,500 MW of nuclear generating capacity. All of this was before a single unit of nuclear electricity was produced in the country – India's first reactor, Tarapur, was only commissioned in 1969! {M. V. Ramana, "Nuclear Power in India: Failed Past, Dubious Future", March 2007, http://www.isn.ethz.ch}.

The reality has been quite different. Installed capacity of nuclear power generation in 1979-80 was about 600 MW; about 950 MW in 1987; 2,720 MW in 2000; and 4,120 MW in mid-2009. Despite the huge increase in electricity generation in India, from a meager 1,800 MW in 1950 to 90,000 MW in 2000 and 147,000 MW in 2009, the total contribution of nuclear power to this has continued to be about 3% only.

The observers are also of the opinion that this utter failure has not been because of a paucity of resources. Practically all governments have favored nuclear energy and the DAE's budgets have always been high. The high allocations for the DAE have come at the cost of promoting other, more sustainable, sources of power. In 2002-03, for example, the DAE was allocated Rs. 33.5 billion, dwarfing in comparison the Rs. 4.7 billion allocated to the Ministry of Nonconventional Energy Sources (MNES), which is in charge of developing solar, wind, small hydro, and biomass based power. Despite the smaller allocations, installed capacity of these sources was 4,800 MW in 2005 (as compared to 3,310 MW of nuclear energy). {M. V. Ramana, "Nuclear Power in India: Failed Past, Dubious Future", March 2007, http://www.isn.ethz.ch}.

Today, notwithstanding over five decades of sustained and lavish government support, nuclear power amounts to just about 4,000 MW. As against this, the current installed base of renewable energy is about 13,200 MW. That is, India's renewable energy capacity is three times that of nuclear energy, despite the fact that the government expenditure on the latter has been many times that on renewable energy {M. V. Ramana, "Nuclear Power in India: Failed Past, Dubious Future", March 2007, http://www.isn.ethz.ch}.

While the country is fortunate that there were no major accidents in the nuclear establishment, the observers are of the opinion that adequate safety of operation in the nuclear facilities within the country cannot be guaranteed for various reasons. While more and more complex safety systems/redundancies are being designed and built for the overall safety of nuclear power stations, it should be noted that they are only increasing the number of sub-systems and the complexity. Such complex systems can result in increasing the risk of failure of individual sub-systems/ sub-components (because of unintended/ unexpected interaction between sub-systems), and increasing new accident modes. All these can result in an increase in the number of automatic shutdown of reactors or catastrophic failures. The rapidity at which a minor problem in the complex system of safety can escalate into a major disaster is great in a nuclear power station, as experienced at Chernobyl.

Tall claims have been made about the capability of Indian nuclear establishments, especially the Atomic Energy Regulatory Board (AERB), to ensure complete safety of nuclear power projects. The fact that the people manning AERB are generally deputed from Department of Atomic Energy (DAE) OR Nuclear Power Corporation Ltd., which is the operator of the nuclear power plants in the country, cannot assure the complete operational independence of AERB. As far as Chernobyl disaster is concerned

Indian nuclear authorities have said that "… secrecy was part of the Soviet culture..." How transparent are the issues with our own nuclear establishments? Mr. A Gopalakrishnan, A former Chairman of AERB, has expressed concern about the complete dependence of AERB on DAE for resources.

There have been suggestions from Indian nuclear authorities that the safe storage of nuclear waste is technically feasible during its active life time. Is it really so, and if so, what about the huge costs involved? Are the efforts to keep nuclear waste safe for thousands of years worthy of all the risks involved? In this regard there are credible and serious concerns that whereas the present generation may get the benefit of electricity from nuclear power, the future generations have to deal with all the risks and costs associated with the spent fuel. Is this fair or socially responsible?

Pro-nuclear advocates have started to argue that nuclear power is a good option against Global Warming. Observers are of the opinion that "flailing nuclear establishments around the world, including India's, have grabbed this second opportunity and made claims for massive state investments in the hope of resurrecting an industry that has largely collapsed due to its inability to provide clean, safe or cheap electricity". Two assumptions made by such pro-nuclear advocates are fundamentally flawed. One is that Global Warming can be contained without fundamentally changing the Western pattern of energy consumption, because nuclear energy is tiny contributor to energy mix world wide. It is generally considered to be impossible to contain Global Warming without significantly reducing the energy consumption levels of Western/ developed countries.

The second flawed assumption is that adoption of nuclear power can make sense as a strategy to lower aggregate carbon emissions. In this regard an example of Japan, a pro-nuclear energy country is given. As Jinzaburo Takagi, a Japanese nuclear Chemist, has showed, from 1965 to 1995 Japan's nuclear power plant capacity went from zero to over 40,000 MW. During the same period its CO_2 emissions increased from about 400 million tons to about 1,200 million tons. Increased use of nuclear power did not really reduce Japan/s emission levels. {M. V. Ramana, "Nuclear Power in India: Failed Past, Dubious Future", March 2007, http://www.isn.ethz.ch}.

Additionally, the amount of energy consumed in the nuclear fuel cycle from the mining stage till its radio active emission gets reduced to safe levels after hundreds of years is estimated to be huge. The contribution to atmospheric pollution at the stages of mining and processing, and radiation leaks to atmosphere are not inconsiderable. Taking all these facts into objective account it is certain that nuclear power cannot be a source of clean and green energy. There are much better, cheaper and safer options.

As a long term policy document, IEP was expected to consider all the related issues w.r.t a technology. But in case of nuclear power technology the issues relating to the environmental impacts of nuclear ore mining, radiation risks involved in the entire cycle, popular local opposition for locating a nuclear reactor in a given area, difficulties experienced in land acquisition, and the crucial issue of long term storage of spent fuel have not even been referred to. IEP is quiet on such issues.

The exorbitant capital and operating costs, cost and time over runs, subsidies and hidden costs in the Indian context of nuclear power plants have also been quietly ignored by IEP. International studies have established that if we take into account the true costs associated with disposing nuclear waste, decommissioning the worn out plants, and insuring reactors against catastrophic failures into objective account building nuclear plants in a competitive electricity market is not simply economical. If the import of technology and fuel are to be relied upon the energy security becomes a major issue which has

not been addressed. It is very strange that IEP has not dedicated much space for the discussion on nuclear power issue.

> *As stated by Hazel Henderson, a columnist (Deccan Herald of 29.6.2010), "Nuclear energy, heavily subsidized since its inception, is still the most inefficient, expensive and hazardous way that humans have ever devised to boil water."*

It is a sector on which the govt. is known to be spending large amounts of national resources, because of which much more discussion of the related issues should have been held while formulating recommendations in IEP. Unfortunately, the views of Dept. of Atomic Energy and the personal views of nuclear power proponents seem to have been simply accepted. The fact that not a single a nuclear reactor has been approved in USA or UK after the Chernobyl disaster; the difficulties faced in 1-2-3 agreement with USA; and public opposition to Nuclear Damages Civil Liability Bill etc. should have been taken into objective account.

There seems to be growing skepticism even to finance the nuclear power. "Too many well known banks that otherwise have taken laudable steps towards sustainability, are still investing heavily in the nuclear industry, putting the world on the wrong energy track. Sustainable banking and financing nuclear energy are simply incompatible" said Johan Frijns, BankTrack coordinator (Annexure 7).

As per IEP's projection even with about 17 times increases in capacity by 2031-32 (from present level of about 3,700 MW to 63,000), nuclear contribution can only be about 8 % of the total capacity (IEP: Page 48). As compared to this huge capacity addition projection many countries are planning to raise the percentage of renewables to about 20% of their energy mix. Being a tropical country India is endowed with much more renewable energy potential such as solar power than many other countries which have shown determination to increase their renewable energy share to 20-25%. Israel is reported to be planning for about 50% share of renewable energy. As per a simulation by Greenpeace International, by 2050 India can meet around 65% of electricity and 50% of the Primary Energy demands from renewable energy sources.

The proponents of nuclear power in India project it as a very safe technology. But the reality in Indian conditions seems to be vastly different. In an article by rediff NEWS at rediff.com on 4th October 2010 under the title "197 suicides and 1,733 deaths at India's nuclear establishments in last 15 yrs", it was mentioned that "197 employees belonging to a number of nuclear establishments and related institutes in India have committed suicide and 1,733 scientists and employees belonging to these centres have died of illnesses like multiple organ failure, lung cancer, cirrhosis of liver etc, as per a report compiled by Mumbai-based RTI activist Chetan Kothari." (Annexure 7A).

There is also a considered opinion of the experts that due to exorbitant costs associated and the base load nature, nuclear power can be at best suited to rich societies with high per capita consumption. But for a poor country, like India, it cannot be a suitable option from any perspective.

In view of the multifarious problems associated with nuclear power plants and its small contribution to overall energy scenario even by 2031-32, our society should thoroughly review whether the resources made available for this sector is well spent on developing the new & renewable energy sources, which will eliminate all the thorny issues associated with nuclear power sector.

6.0 Inadequate attention to social and environmental aspects – major concerns to society

IEP's projection that the total electricity generating capacity should increase from about 160,000 MW in 2006 to 788,000 MW in 2031-32 would require addition of about 25,000 MW every year for the 25 year period. This is a gigantic task, especially in the backdrop of our past experience wherein not even ten thousand MW could be added every year. Hitherto, the record for power capacity addition in a single year was in fiscal 2009-10, when 9,585 MW was added.

The social and environmental impacts on our society associated with such large scale additions, especially through conventional power plants, and the long term perspective of the welfare of the society has been ignored in IEP. The policy document seems to have ignored the fact that if social and environmental issues are not effectively addressed the economic wellbeing of various sections of the society will be severely eroded sooner or later. Hence the real challenge before the country is to ensure adequate quality/quantity of energy/electricity supply to all sections of the society, while taking care of the other needs of the society such as clean air, safe drinking water, healthy food, right to live peacefully in one's chosen place, healthy environment etc. Sadly IEP has failed to take such a holistic view of the welfare of the society when looking at the energy requirements.

Economic impacts on our society of the inefficient electricity sector are not inconsiderable.

> *As per the report of the 13th finance commission, which was tabled in the parliament on 25.2.2010, unless the public utilities engaged in transmission and distribution of electricity take urgent measures to improve the efficiency of operations the combined losses at the national level may increase from Rs. 68,643 crores in 2010-11 to Rs. 1,16,089 cores by 2014-15. Such huge losses year after year have led to deprivation of adequate funding to other crucial sectors of our developmental process such as drinking water supply, poverty alleviation, health, education, rural infrastructure etc. Such huge losses year after year cannot be sustained, and will have huge deleterious impact on the developmental front. The huge addition proposed by IEP to the large size conventional power projects will lead to increase in such losses due to increased coverage of T&D network and due to the increased complexity of electricity network.*

A common issue with any of the large size conventional power plant is the demand for large tracts of land, and natural resources like water and minerals such as coal or nuclear material. Being a densely populated country with limited natural resources, and struggling to uplift a sizeable percentage of the population from poverty, India cannot afford not being extremely careful about how its natural resources are put to societal cause. There is a huge pressure on the land, especially the fertile agricultural land. Farmers generally refuse to part with their lands, which is so important to them from economic, social and emotional perspective. Forceful acquisition of such agricultural lands, which are their only source of livelihood, most often without adequate compensation, have been making these farmers very vulnerable to market forces.

> *In 2000 the World Commission on Dams had stated: "Dams have made an important and significant contribution to human development, and the benefits derived from them have been considerable. In too many cases an unacceptable and often unnecessary price has been paid to secure those benefits, especially in social and environmental terms, by people displaced, by communities downstream, by tax payers and by the natural environment."*

Whereas project affected people with legal rights to lands may get some compensation (however inadequate such compensation may be) from such large projects, generally there are a large number of people who have no such legal rights, but who have been living in that area depending on common resources like water, forests, grazing fields etc. Such people and others like agricultural laborers, artisans, shop keepers, domestic helpers etc. who will be affected by the projects but cannot get any compensation.

6.1 Impact on land and water

Several credible reports have estimated that over 4 Crore people have been displaced from their natural habitat since independence in the name of various developmental projects, including power projects. Such displacement is one of the main reasons for the mushrooming urban slums in the country.

The hardship experienced by such project affected families (PAFs), as described by the media, has made others to be aware of the threats to their livelihood, and hence in recent years people are fiercely opposing forced acquisition of agricultural lands. Opposition to large conventional power projects are being reported regularly in the media. Some of such popular protests in recent years are: Dadri in UP (a large size gas power plant); Haripur (Nuclear Power Plant, West Bengal); a total of about 60 power plants in Vidarbha and Coastal Maharastra; more than 15 power plants in Vizag area of Andhra Pradesh; few coal power plants in Karnataka; a number of hydel power plants in Uttarakhand, Arunachal Pradesh and Sikkim etc.

A proposal of setting up 47 new coal power plants in the backward Vidarbha region of Maharashtra has met stiff resistance from various quarters as it will use up large portion of water in nearby rivers, which have almost dried up due to poor monsoon in 2009 (Annexure 8). Such a large number of coal power plants totaling a power production capacity of 20,000 MW in one small area of a state will create havoc for its people, natural resources and environment.

As per CEA norms a coal power plant would need about 1 acre (0.4 Hectare) of land per MW of installed capacity, excluding mining area, and additional lands for transmission lines. At this rate additional coal power capacity of about 245,000 MW, as per IEP, will need about 245,000 Acres (about 98,000 Hectares) of additional land, most of which is likely to come out of the agricultural lands. This, in addition to the land required for about 120,000 MW of additional hydel power and 50,000 MW of nuclear power, and the land required for the associated mines, transmission lines, townships, roads & railway lines may need about 0.5 million acres (0.2 million Hectares) of additional land. Finding suitable land of this size with minimum hardships to the affected people and avoiding usage of fertile agricultural/ forest lands will be a gigantic challenge. The associated popular opposition will most likely lead to Singur / Kalinganagar type of social chaos. Can our society afford to ignore this sort of social unrest? IEP has not addressed this issue.

Arundhati Roy, in her article “The Greater Common Good” quotes N.C. Saxena, Secretary to the Planning Commission, as saying that nearly 4 crore people have been displaced by dams in the country since independence. That’s more than three times the number of refugees created by the Partition in India. Should this not be serious concern for a poor country like India?

Another area of major concern with conventional power plants is the issue of large quantities of fresh water. Many coal power plants in different parts of the country are already facing water shortage. Indian coal power plants require huge quantities of fresh water per 1,000 KWH of energy production. For the proposed 400,000 MW by 2031-32 this requirement will be very huge (few billion Cubic meters per year). A typical 500 MW thermal power plant using coal emits around 105 tons per day (TPD) of SO_2 (at 100 per cent load factor, 0.7 per cent sulphur content in coal), 24 TPD of NO_2 and 2.5 TPD of particulate matter (at 34 per cent ash content, 99.9 per cent electrostatic precipitator efficiency) and ash around 3,000-3,500 TPD. All these pollutants from coal power plants will be a major threat to our society (Annexure 9). It is very unfortunate that IEP has not even referred to either the impact of these pollutants or how they will be managed effectively.

Many parts of the country are already facing severe shortage of water for drinking and agricultural purpose. With hugely growing population and penchant for additional large industries there will be unmanageable demand for water in the years to come; and huge addition to coal power capacity can make it a national crisis. A credible scenario would be the diversion of fresh water sources to industrial purposes, including coal power plants, putting human welfare at great risk. With ground water removal already reported as being at unsustainable level and many rivers are getting dried up for various reasons, providing fresh water supply to large number of additional coal power and nuclear power plants will pose serious socio-environmental problems.

As a welfare society, with a large percentage of vulnerable sections, we have a duty of care to consider the rights of such people to live peacefully. Without considering these issues in any detail IEP has failed in such a duty of care.

6.2 Global Warming Impact on Biodiversity

All the conventional technology electricity sources release many of the highly dangerous pollutants such as ash, Mercury & GHGs from coal power stations, CO_2 from liquid fossil fuels, radiation from nuclear wastes, Methane gas from dams etc. Coal power stations are considered to be the worst polluters of air, land and water. Diesel, petrol, and natural gas used for power generation also are associated with GHG emissions. There are serious environmental issues with each of these fossil fuels whether in mining, processing or end usage. Though nuclear power generation is touted as clean process, the mining and processing of nuclear fuels have huge environmental implications. The serious concerns about radiation effects have not made it still unacceptable to the societies all over the world. The dam based hydro power projects may appear to be an environmentally friendly option, but the submergence of plant matter through reservoirs is a source of Methane gas which is much more potent than CO_2 as a GHG. One estimate indicates that the GHG emissions from the dams in India are about 18% of the total GHGs emissions in India. In this context it is not clear how IEP consider dam based hydel power as Green energy.

Acid rains due to sulphur content in coal has been identified as a major threat to bio-diversity. Despite tall claims to reduce sulphur di oxide emissions, coal power plants are reported to continue to affect the bio-diversity in the areas in about 100 kM radius.

These conventional energy sources are generally known to pollute the surrounding areas in one way or the other, and have deleterious impact on fresh water sources and atmospheric air. Plant kingdom around the coal power stations are reported to be affected badly by the coat of fly ash on the leaves.

Nuclear fuel wastes are known to remain radio active for thousands of years, and coal ash from ash ponds are likely to wash to the nearby rivers/streams during heavy rains. There is always a lurking danger of breach of safety of storage of these wastes either due to natural or human reasons.

A major aspect of the natural wealth of the globe which gets severely impacted by conventional power plants is the bio-diversity. Being one of the earliest civilizations, our society has attached a great cultural and spiritual value to rivers and the rich biodiversity associated with them. However, since independence our treatment of rivers and the rich biodiversity associated with them has been one of grossly callous in nature.

- A river is known to be most beneficial to the flora, fauna and humans only if its water is fresh and flowing continuously. One or more dams on a river will severely affect this characteristic of a river, and hence will deprive us of all the associated benefits.
- It is very disturbing to note that there are no legally mandatory norms in our country which stipulates the minimum fresh water flow in a river with or without hydro electric dams. Authorities seem to consider the water flowing to sea as a waste, without appreciating the need for such a flow to conserve the ecosystem. Such 'Environment Flows' are essential to maintain the ecological integrity of a river and its associated ecosystems, and of the goods and services provided by them.
- In view of the fact that most hydro electric projects involve diversion of river water through tunnels of many kM in length, if there is no minimum 'Environment Flows' the stretch of the river between the dam and the point where the water passing through the hydro turbines reenter the main course of the river will become dry. In many cases this stretch of a river can be few kM, and the river ecosystem in such a stretch could be destroyed.
- Dams prevent the silt from flowing down the river, and seriously affect the availability of rich nutrients to the bio-diversity down stream.
- The hilly terrains, where most of the dams are built in general, such as Himalayas and Western Ghats are not only recognized as bio-diversity hotspots but also as fragile ecosystems with many species of flora and fauna amongst the endemic types. Dam building activities like digging, blasting, excavations, dumping of debris, road building etc. are more than likely to severely damage the bio-diversity in these areas.
- Dams are known to have reduced populations of migratory fishes or caused extirpation of genetically distinct populations, as well as diminishing estuarine fishes in most continents. In North America studies have revealed that fresh water extinctions due to dams are five times as high as those on land.

Because of its huge & dense population, limited natural resources and long coast line, India is expected to be one of the most impacted countries due to Global Warming and Climate Change. As per Inter Governmental Panel on Climate Change (IPCC) some of the catastrophic consequences of Global Warning beyond 2^0 Centigrade increase are: famines and droughts threatening millions of lives; worldwide drop in agricultural and horticultural crops; up to 3 billion people at risk of flooding and without access to fresh water supplies; destruction of half the world's nature reserves and a fifth of coastal wetlands; global sea levels increase by more than 20 feet; significant effects on biodiversity and ecological productivity; potential for international conflicts, border disputes, war due to water and food shortages, forced migration, extreme weather events, huge impact on general health etc.

As per Inter Governmental Panel on Climate Change (IPCC) - IV Assessment Report "Emissions from deforestation are very significant – they are estimated to represent more than 18% of global emissions"; "Curbing deforestation is a highly cost-effective way of reducing greenhouse gas emissions." Large conventional power projects are all major contributors for deforestation either through dams, buildings, mines, transmission lines and pollutants like coal dust, coal ash and acid rains.

In this background all out efforts to mitigate and adapt to the Global Warming by reducing the Global GHG emissions to the lowest possible levels are considered an urgent necessity by the global community. Being a country with the second largest population India's potential to be one of the three biggest GHG emitters is credible. In view of the huge contribution of conventional power plants to Global Warming through emission of Green House Gases such as CO_2, Nitrous Oxide and Methane, our society has a duty of care not only to protect its own population but also to the international community in reducing the number of such conventional power plants.

Looking at the large number of power projects advocated by IEP and those being planned/implemented all over the country it is hard to believe that the stated objectives behind the missions such as National Mission on Sustainable Habitat; National Water Mission; National Mission for Sustaining the Himalayan Ecosystem; National Mission for a "Green India"; National Mission for Sustainable Agriculture have any realistic chance of being fully met.

In a report released by MoEF in 2010 (*India: Greenhouse Gas Emissions 2007*) it is indicated that CAGR of GHG emissions from electricity sector between 19994 and 2007 is 5.6%, and that about 38% of all GHG emissions in our country is associated with electric power sector. Additionally, within the energy sector electricity alone accounts for 65.4 % of all GHG emissions. In view of such large contribution of electricity to the total GHG emission of the country, there is an urgent need for reducing the emissions from this sector, which is possible only by minimising the number of large conventional power projects, and not by increasing them by a huge magnitude as recommended by IEP.

It is surprising that IEP has not discussed the huge possibilities with Carbon Trading, Clean Development Mechanism, and the potential huge revenue from them. Also IEP has not discussed the relevance of the objectives of National Forest Policy or Policy on Non-conventional Energy Sources or National Water Policy to the integrated energy policy. As a planning commission document it should take into account all such national policies into objective account.

Table 6: Sector wise % GHG emission in India during 2007

(Source: MoEF Report in 2010)

	Energy	**Industry**	**Agriculture**	**Waste**
Electricity	37.8 %	-	-	-
Transport	7.5 %	-	-	-
Domestic	7.2 %	-	-	-
Others	5.3%	-	-	-
Cement	-	6.8%	-	-
Iron & Steel	-	6.2%	-	-
Others Industries	-	8.7%	-	-
Total	**57.8 %**	**21.7%**	**17.6%**	**3.0%**

The inextricable link between development, secure energy and green environment of suitable carrying capacity should always be a primary plank in our national policies. IEP has not taken such a holistic stand.

6.3 International Obligations

IEP's recommendation to increase the installed power capacity by about 5 times, mostly through large size conventional power projects, will have a question mark on our country's ability to respect our commitment to international community.

> *In the Cocoyoc declaration of 1974, at Mexico, as part of UN Conference, it is said on the purpose of development:"Our first concern is to define the whole purpose of development. This should not be to develop things but to develop man. Human beings have basic needs: food shelter, clothing, health, education. Any process of growth that does not lead to their fulfillment - or even worse, disrupts them – is travesty of the idea of development. The problem today is not one primarily of absolute physical shortage but of economic and social mal-distribution and usage." Large conventional power plants lead to the displacement of thousands of people, who because of highly insensitive rehabilitation process are most likely to become destitute. Additionally, because of high rates of pollution people living close to thermal and nuclear power plants experience severe health problems for no mistake of theirs.*

Convention on Biological Diversity was signed by 156 states in 1992, the objectives of which are the conservation of various components of biological diversity, the sustainable use of its components, and the fair and equitable sharing of the benefits arising out of the utilisataion of genetic resources. India, which is a signatory to this convention and which is also one of the most important bio-diversity hotspots as per UN, cannot stake claim as a diligent protector of its own bio-diversity. The large size dams are not only reducing the land based bio-diversity by drowning thick forests, but also are reducing aquatic bio-diversity by denying water and precious silt to the downstream of the dam. While a recent statement by Sri. Jairam Ramesh, Minister of Environment & Forests has indicated that almost one-third of the country's top grade coal reserve would not be available for mining as these areas are now considered to be ecologically too fragile to allow mining, it should be noted that almost all coal mines which were opened in the past and those which are going to be opened were /are below thick forests. If we continue to opt for more of coal power stations the rich bio-diversity in these forests will be destroyed.

A recent report by MoEF "Achieving 2010 Biodiversity Target: India's contributions" has copiously described the rich biodiversity in the country, the threats to it and the remedial measures. It can be safely said that without holistically reviewing the recommendation of IEP to build large conventional power plants, we, as a society, cannot take any credit for contributing to the conservation of global biodiversity.

At a time when there is increasing evidence of tens of species getting extinct every year, the international community has recognized the urgent need to conserve bio-diversity throughout the world. With only 2.4% of world's land area India accounts for 7-8% of the recorded plant and animal species of the world, and is recognized as a mega diverse country (*MoEF report: "Achieving 2010 Biodiversity Target: India's Contributions"*). Year 2010 being declared as the International Year of Biodiversity, we have a duty of care at least to introspect on the impact on biodiversity of huge number of large size conventional

power plants proposed under IEP.

World Charter for Nature was adopted by consensus by UN General Assembly in 1982. It has provided some guiding principles for protecting biodiversity (Bio-diversity Impact of Large Dams, prepared for IUCN / UNEP / WCD). Some key principles so enunciated are: (i) Activities which are likely to cause irreversible damage to nature should be avoided; (ii) Activities which are likely to pose significant risk to nature shall be preceded by an exhaustive examination; their proponents shall demonstrate that the expected benefits outweigh potential damage to nature, and where potential adverse effects are not fully understood, the activities should not proceed; (iii) Environmental Impact Assessment should be thorough, be given sufficient time, and be carried out in an open and transparent fashion.

As per the Convention on Biological Diversity it will be a wise policy to apply Precautionary Principle and take necessary action to conserve Bio-diversity before components of it are permanently lost.

As per STERN REVIEW – 'The Economics of Climate Change', the Climate Change could have very serious impacts on growth and development. The costs of stabilising the climate are significant but manageable, while delay would be dangerous and much more costly. The benefits of strong, early action on climate change outweigh costs. This Review has estimated that certain scenario of Global Warming may result in poor countries like India suffering economic costs of about 20 % of its GDP, whereas the mitigation of the same now can be achieved at a cost of about 1% of present GDP. The Review also indicates that more we delay in addressing the Global Warming the higher we will have to spend in mitigation of the same in future. In this background adequate investment to minimise the Global Warming impacts of conventional power plants is considered worth the huge cost.

The international community has attached so much importance to the forests that the main outcome of the UNFCC meet at Poznan few years back was that the resolution to set in motion an international mechanism on 'Reducing Emissions from Deforestation and Forest Degradation' (REDD) was adopted. Large conventional projects and coal mines can only reduce the all important forest cover and bring negative changes to the forest area that limit its production capacity.

A report "Bio-diversity Impacts of large dams" prepared for UNEP & IUCN, has listed a large number of such impacts. Among other things it says that about 60% of the world's river flow is regulated with serious implications on biodiversity dependent on rivers. India's contribution to this number is not small.

In May 2010 MoEF released the draft Mission document on National Mission For A Green India. As per this document the three fold objectives to be achieved in next 10 years are: (a) double the area to be taken up for afforestation / eco-restoration in India: (b) Increase the GHG removals from India's forests to 6.35% of India annual total GHG emissions; and (c) enhance the resilience of forests /ecosystems. All these will be possible only if there is adequate containment of deforestation and degradation of the existing forests. To loose a considerable part of the rich tropical forest with very high bio-diversity value because of large size power projects will negate the very objective of this mission.

Keeping the letter and spirit of these and large number of other national/ international reports, and conventions it will be no exaggeration to state that India, as a responsible member of the international community, has largely failed to implement the necessary policies to safeguard the interest of our bio-diversity, environment and weaker sections of the society by continuing to ignore the huge implications of building a large number of conventional power projects.

6.4 Constitutional Obligations

When we look at the huge inefficiency prevailing within the electric power sector and the large additions to conventional power plants in the country with a correct perspective, the violation in letter and spirit of many provisions of various Acts of parliament and the very Constitution itself becomes obvious. As per the sections 48 (a) and 51 (a) (g) of our Constitution it is the duty of the STATE and every citizen to make honest efforts to protect and improve our environment by protecting and improving rivers, lakes, forests and living beings. IEP has failed to accord due importance to this critical duty of care.

When we look at the recommendations of IEP from the perspective of what the conventional power plants have achieved in the past, it is almost impossible to notice the compliance of the letter and spirit of Indian Electricity Act 2003, and National Electricity Policy as far as salient features such as efficiency, economy, responsible use of natural resources, consumer interest protection, reliable supply of electricity, protection of environment are concerned.

Whereas the National Forest Policy recommends that 33% of the land mass should be covered by forests and trees for a healthy environment, our practice of continuing to divert forest lands for large power projects will bring this percentage much below even the present low level of 24% in the country. Despite three important Acts of our parliament namely Environmental Protection Act, the Forest Conservation Act and the Wild Life Protection Act aiming to provide adequate protection of our natural wealth, unscientific and unrestricted growth in conventional power capacity has continued to threaten the flora, fauna, rivers and environment. IEP has failed to address these issues.

If our society continues to deem each of the proposed conventional power plant as essential and that the interest of forests/rivers/biodiversity are expendable then the provisions under various laws of the land will remain in books only.

As a responsible nation, have we exhibited the necessary commitment and means of following various international guidelines in an objective sense to adequately protect flora, fauna, rivers and environment?

6.5 Green India Mission

One of the 8 missions declared under National Action Plan for Climate Change (NAPCC) is Green India Mission, under which the area for afforestation is proposed to be doubled in 10 years. This mission has a budgetary proposal of Rs. 40,000 crores for this objective. It is difficult to visualize how the real objective behind this Mission can be realised, if a large number of additional coal mines are permitted to be opened, and huge tracts of natural forests are allowed to be drowned by dams for hydel power plants as has been the recommendation of IEP. Additional nuclear mines also will destroy natural forests. Unless we address these fundamental issues, it will not be unrealistic to suggest that most of the proposed Rs. 40,000 crores budget may not end up in optimal use to our society.

Whereas Green India Mission aims at bringing additional land area under afforestation measures, such forest & tree cover can never compensate the rich bio diversity of our natural forests which will be destroyed by large conventional power projects.

One of the common complaints against the developers of large projects is that much more than the really needed area of land is being acquired. Such a practice will render more people homeless than that umber absolutely needed. Such extra pieces of land are either sold for a profit or left unutilized. In a country where the pressure on agricultural land is increasing heavily, the land acquisition process for any such projects have to be very pragmatic, and should always be monitored by a group of experts and local people. IEP seem to have ignored such issues.

At a time when other primary sectors of our economy like poverty alleviation, health and education are starved of funds, must we continue to pour thousands of crores of rupees in adding new generating capacity through conventional technology, only to end up with productive and economic usage of about 20% only, without first exploring cheaper alternatives? Should we not consider the techno-economically viable alternatives first, which are generally associated with smaller gestation period, much lower costs, minimum or nil environmental impacts and the absence of public opposition?

Hence, while planning large projects such as dam based or coal fired electricity generating projects, the very likely possibility of project authorities failing to fulfill their commitments and/or strong opposition by the public should be factored in, because such projects are likely to be delayed indefinitely by controversies.

7.0 Low level of confidence on renewables - focus on grid interactive capabilities

IEP has not indicated a high level of confidence in the ability of the new and renewable energy source to meet the energy demand, though it recognizes the need to provide paramount importance to develop the same (IEP: page 123). The high capital cost and inadequate investment in R&D are quoted as major constraints. The potential for on-shore wind power is projected as between 45,000 MW and 65,000 MW. Because of low level of utilisation factor of wind mills so far, IEP estimates that the contribution to energy would be relatively small. Much better level of confidence is shown by IEP in solar power, bio-mass and bio-fuel potential.

The total potential of solar PV and Solar Thermal in the country is estimated to be about 2,400 Million Tons of Oil Equivalent (Mtoe) per year as per IEP (table 3.5, Page 37). This is in stark comparison to the estimated total primary commercial energy requirement of the country in 2031-32 of about 1700 Mtoe. What it basically means is that if enough emphasis is given, solar power alone has enough potential to meet all our energy demands.

Table 7: N&RE potential in India

	Potential (Grid interactive power only)
1. Wind energy	50,000 MW (Onshore only)
2. Small hydro	15,000 MW
3. Solar	Over 5,000 trillion kWH/year Potential (estimated to be many times more than the total energy needs of the country)
4. Bio-mass	> 50,000 MW
5. Ocean Wave	With about 7,000 kM of coastal line it should be huge, but no estimates available

(Source: MNRE, Govt. of India)

According to the World Institute of Sustainable Energy (WISE), the grid connected renewable energy potential of the country is much more than that projected by MNRE.

- Wind Energy – 100,000 MW;
- CSP based solar power generation – 200,000 MW;
- Solar PV based power generation – 200,000 MW (here available space may not be a problem, if we also consider all the rooftops available).

Whereas as per IEP projection the demand for electricity generation by 2031-32 is about 3,600 Billion kWH/year, solar energy potential in the country is estimated to be about 5,000 trillion kWH/year. The true potential of various modes of solar power is so great that even if we can harness about 0.1% of it, all the energy needs of the country can be met.

IEP has basically looked at the grid interactive potential of renewable energy sources. These sources, especially solar energy has very huge potential, if distributed type potential such as small size roof top or community based renewable energy plants are considered. The same is true with all other renewable energy sources. Because of the huge losses involved in Transmission and Distribution of generated electricity, all the attendant problems such as theft, organizational issues, huge capital expenditure to the state, technical problems such as voltage stability etc. which are salient features of a grid interactive energy sources, distributed renewable energy sources are best suited for rural electrification and for small loads such as lighting, other domestic appliances, small pumping needs etc. The potential of the new & renewable energy sources can almost be termed as unlimited when they are effectively used as distributed energy sources.

IEP has failed to objectively view the acute crises the country is facing due to inefficiency in the present grid based centralized power plants system, and the obvious benefits of distributed renewable energy sources. Following are the main advantages of distributed renewable energy sources as compared to the present grid based system of large conventional power plants:

- Will greatly reduce the effective demand on the grid based power supply system; will drastically reduce the T&D losses; and vastly improve the power supply to those consumers essentially needing the grid supply; much better voltage profile; leads to much reduced spending on grid management;
- Will drastically reduce the need for fossil fuel based, dam based and nuclear power stations and the associated transmission & distribution network; reduced complexity in system operation;
- Will assist in drastically reducing the GHG emissions and other pollutants;
- Will provide a sustainable, environmental and people friendly energy supply model;
- Will accelerate the rural electrification due to shorter gestation period of individual projects;
- Will lead to increase in rural employment opportunities, and hence assists in minimizing urban migration;
- Will require negligible or nil additional resources such as land and water;
- Their impact on the environment will be minimal, and they are inexhaustible;
- Lead to much reduced growth in demand (CAGR) for grid electricity;
- Avoided costs of recurring fuel expenditure and of peak load power stations;
- Absence of the need for people's displacement.

IEP has failed to acknowledge these critically important and recurring benefits, and has come to the unfortunate conclusion that due to large areas of land required and huge capital expenditure required for Grid interactive renewable energy plants, their contribution to electricity requirements in 2031-32 cannot be high. Whereas the land required for Grid interactive renewable energy plants will be large, the same issue gets almost completely eliminated when we focus on small size roof top or community based renewable energy plants.

Roof top or community based renewable energy plants, such as solar water heaters and solar PV panels are already being used in our country. In effectively harnessing the solar energy in our country the roof top surface available is enormous: individual houses, educational institutions, commercial establishments, hostels and hotels, factories, storage houses, office buildings etc. Similarly, the potential for small size wind mills and a hybrid of wind mill and solar PV on roof tops is not inconsiderable. Community based systems such as bio-mass, wind mill or solar systems either individually or a hybrid of two or more can entirely solve the energy needs of rural communities. For inexplicable reasons IEP has not even considered this huge potential. Such small size renewable energy plants have the potential to meet almost all the smaller electricity loads in the country, and can reduce the net demand on the grid by a considerable margin. An appropriate feed-in-tariff to effectively harness the excess electricity generated by such distributed renewable energy plants will probably eliminate the need for most of the proposed conventional power plants. IEP has failed to appreciate this enormous potential.

Two most common questions raised in case of new and renewable energy sources are that they are not firm power and that their comparable cost with conventional energy sources is high. The reality behind these issues is as follows:

- Many applications like lighting loads, water pumping for domestic and smaller agricultural needs, water heating for bathing etc. are not heavy and do not require 24 hours supply. Lighting loads can be adequately met by backup battery systems when the main sources like solar or wind energy is not available. These battery systems can be charged by the respective energy sources. Applications like solar water heating with adequate capacity water storage facility need no battery backups. Solar water pumps for lighter agricultural or domestic loads are ideal for usage during the sunlight hours. These can also function much more reliably in conjunction with other renewable energy source of bio-mass and wind turbines where feasible. These sources are already in use in the country.
- Though it is true that the initial cost of these new and renewable energy sources seem to be high as compared to the conventional energy sources, it is only because the society has already invested very heavily for the infrastructure required for the development of the latter. Also, the real cost of recurring fuel needs in case of coal, diesel, natural gas or nuclear fuel will be avoided in the case of renewable energy sources. Whereas both the capital cost and energy cost from the conventional energy sources is increasing all the time, the same is opposite in case of new and renewable energy sources. Already the cost of new and renewable energy sources has come down by many times in the last decade. In addition, if we take the environmental costs, social costs, health costs, Global Warming mitigation costs, T&D losses and the large infrastructure required for the grid quality conventional energy sources, the distributed energy generation based on new and renewable energy sources will be much cheaper.

  As mentioned earlier, the total budgetary spending on new & renewable energy sources by the union govt. is a small fraction of that on nuclear power.

- The benefits of the new and renewable energy sources will be optimum when we consider them as distributed generation sources. An objective analysis of all the societal costs and real benefits over the duration of the known life cycle of conventional energy sources as compared to that of new and renewable energy sources will reveal that the renewable energy sources are of much higher benefits in almost every situation.

Though IEP has acknowledged that the exhaustible conventional power sources cannot be relied on for long, the new & renewable energy sources have not been given the due recognition. In this regard one can say IEP has failed to recommend a suitable energy policy for the country.

International Energy Agency (IEA) has recently released it's estimation that by 2050 about 22% of the global energy can be met by solar power alone.

What is needed for our resource constrained society is a careful choice of the most suitable energy option for a given category of consumers and in a given geographical area. It is already acknowledged at various levels of administration that a grid based energy system with large conventional power plants at the centre of focus cannot meet the energy requirements of remote villages satisfactorily. A small residential load in a remote place in Bihar need not wait for grid quality power from a giant thermal power plant in West Bengal; OR a 3 HP pump set for drinking water needs of a village in Rajasthan need not seek power from nuclear power park in Gujarath; OR few street lights in a village in the foot hills of Uttarakhand need not ask for power from the large Tehri hydel project. Most of such small and remote loads throughout the country can be and must be supplied reliably and economically with renewable energy sources locally. If a majority of such small loads can be shifted to locally controlled renewable energy sources a considerable amount of power from the grid will be released, which in turn can be supplied to large loads such as factories and electric traction in urban areas. A holistic and objective outlook is needed in this regard.

The future of our country entirely depends on how effectively our society will be able to harness the various energy sources including the huge renewable energy potential within the country. An integrated energy resource management approach is absolutely needed to avail energy security. The renewable energy sources alone can provide the energy security to our rural population, and not the dependence on external resources such as coal, petroleum and gas as recommended by IEP.

8.0 Other Issues of concern

Some of the other major issues of concern in IEP are as follows:

8.1 Heavy dependence on imported fuels and energy security

IEP has clearly acknowledged the imminent limit to fossil fuels, including Uranium, in our country. It has discussed in length the need to import coal, petroleum products and nuclear fuels to have a total generating capacity of 778,000 MW by 2031-32. It even suggests that hydel power itself can be imported from Nepal and Bhutan. It has also referred to securing interest in oil, gas and coal fields abroad.

If our country is to depend so much on import of fuels, energy and technology the energy security cannot be assured. The political uncertainty in supplier countries, disruption to supply lines such as ocean routes due to war or natural calamities, price volatilities, terror threats etc. cannot provide any reasonable degree of confidence to rely upon such imports. IEP has not even discussed these risks.

8.2 No control on mushrooming number of private vehicles

With our petroleum product import expected to touch 85% of our consumption by 2015, there should have been adequate attention towards reducing such import dependence. Instead IEP has discussed on how to secure the supply of petroleum products from overseas.

It is sad that not many discussions seem to have gone into various aspects of reducing the consumption of petroleum products. If the government continues with the policy of encouraging the manufacture of more number of private passenger vehicles, and providing incentives for the sale of more of such vehicles the serious problems, which the country is already facing in transportation sector, will escalate. The air pollution, demand for wider roads, express ways and petroleum products will reach unmanageable proportions. IEP has not discussed the associated issues.

8.3 Energy Plantations

While referring to the need to harness the renewable energy sources, IEP seem to consider only large size grid interactive power plants. In this regard the recommendation has been to establish energy plantations growing trees suitable for bio-energy. While this recommendation to use the need for compensatory afforestation to be used as opportunity to develop energy plantations may seem to be a green idea, there is a danger of diverting agricultural lands for such plantations unless stringent measures are implemented. If large size bio-mass based power plants are to be established there will be undesirable pressure on fertile agricultural lands to grow non-food crops. Serious implications of diverting agricultural lands to such non-food crops are already being reported from other parts of the world, especially Brazil and USA. Our future energy policy must take such externalities into objective account so as to achieve the welfare of alls sections of the society. In search of energy security the food security should not be compromised.

As discussed earlier, the renewable energy sources are most beneficial when they are harnessed locally instead of large sizes in few locations only. The bio-fuel species such as Pongemia and Jatropa have been growing in our villages for hundreds of years on non-agricultural lands, on the fringes of the farms and agricultural fields, at the fences of the residences etc. Put together at the country level such spaces provide a huge base for growing bio-mass in adequate quantities without endangering food crops. Additionally, the conversion of most of such biomass to energy in distributed fashion at the level of communities through commercially viable models, will greatly assist in economic development of the rural communities.

Dedicated estates to grow bio-mass / bio-fuels, as recommended by IEP, must be carefully reviewed to strictly avoid diverting the agricultural lands. With already a huge population base and growing all the time, our country cannot afford to experiment on a critical issue such as food security.

8.4 No mention of peak use of fossil fuels

At the international level there is a preponderance of acceptance of the need to reduce /contain the consumption of fossil fuels in order to check the Global Warming phenomena from running out of

control. Many institutions like Inter Governmental Panel and Climate Change (IPCC) have clearly suggested that the consumption of fossil fuel should peak as soon as possible. Some of these credible scientific reports indicate that this should happen during nest 10-15 years. Many countries like Norway and New Zealand have already announced their plans to achieve such peaks before 2020.

IEP has not even discussed this issue, let alone suggesting a peak year. Unless we start looking at this issue seriously and urgently India will not only be blamed for it, but will also face the consequences. There is already tremendous pressure on fast developing countries like China and India to reduce their GHG emissions. In this context it is essential that we work on a plan to reach the peak consumption by a certain time frame at least in case of coal and petroleum products. A tentative target year such as 2020 to reach peak consumption of coal may help us to focus our efforts to manage our energy demand/supply situation accordingly. Suitable policies by the state and union governments in this regard will also enable the public and private institutions to channel their resources into developing credible alternatives. Without such a target year we will continue to depend on imports and also run the risk of growing into the largest emitter of GHGs.

The issues involved in the option of shifting light passenger vehicles, such as cars and two wheelers, to battery driven mode, and to reduce the use of natural gas for power production in the medium run, and eliminating its use for power production in the long run should be seriously looked into. Both these applications can be made to depend on renewable energy sources such as solar, bio-mass or wind.

Society should take a very serious view of the wastages happening in vulgar applications such as formula one racing, dirt road racing, cross country racing, drag racing etc. As a poor country with heavy dependence on import of petroleum products such wastages should be effectively discouraged.

A large number of small size diesel/electricity generators, in the power range of 1- 10 kVA are known to be running all over the country to meet the needs of commercial establishments. These are known to be highly inefficient and causing local atmospheric pollution. Such applications of diesel should be heavily discouraged by improving the reliability of grid supplied electricity and by suitably taxing such diesel usage. A considerable portion of these applications are known to cater to lighting needs only, which can be effectively supplied by solar PV panels.

A rigid time line to achieve these targets, such as 2015, should be drawn. Adequate and carefully targeted investments in popularizing the renewable energy sources seem to be the most suitable option available to us in this regard.

8.5 Recommendation for creating coastal infrastructure for import and use of coal

While making such a recommendation (Page 51) IEP has failed to consider objectively the socio-environmental impacts of a large number of coal power plants in the ecologically sensitive coastal regions. Most of the coastal regions of the country are densely populated, and a majority of the people there depends on the natural resources such as ocean, estuaries, wetlands, fishing, coconut and paddy crops etc. Uncontrolled use of coal, which is most likely to occur with the implementation of IEP recommendations, in such sensitive areas will devastate these resources and make the locals destitute in their own lands. Vulnerable sections of these regions such as fishermen, with no other professional skills, will be devastated with polluted oceans which certainly will impact the fish population.

Most of the coastal regions have wetlands, which are ecologically very important. A large number of coal plants proposed/being implemented on the coast of Andhra Pradesh, Tamil Nadu, Orissa and Maharastra will ruin these rich habitats for bio-diversity, and deny the associated benefits to the locals. Availability of fresh water is already a serious problem in these areas, and coal dust can endanger even this existing fresh water resources.

8.6 Focus only on centralized energy infrastructure

IEP seem to have focused only centralized electricity infrastructure with large size power plants in few locations and a complex network of transmission, sub-transmission and distribution lines and equipment taking electricity to all corners of the country. IEP has failed to consider the serious problems with such a large network. The low levels of efficiency, huge complexity in its planning and operation, the economics etc. have been ignored.

If we look at the grid based coal power plants, which are predominant in Indian scenario, the dismal picture becomes evident. Due to technological constraints about 67% of the heat energy available from the coal is lost in a coal power plant; about 25 to 30% of the remaining energy in the form of generated electricity is lost in transmission, sub-transmission and distribution to widely distributed loads. These losses effectively mean that only about 10% of the coal energy will be put to economic/productive uses.

The distributed type of renewable energy sources will fare far better in this regard. Solar photovoltaic panels that are in commercial use now have already achieved efficiency levels of 13- 15%. If these are used close to the usage points, such as roof top panels, the energy loss in the associated T&D is negligible. The efficiency of solar photovoltaic panels is reported to have reached about 25% in laboratory conditions with improved material technology. Wide spread use of distributed renewable energy sources will also reduce the overall T&D losses in the system by largely meeting the smaller loads locally.

The future of electricity demand/ supply systems in our country should be based predominantly on decentralized energy sources meeting individual or local loads.

9.0 Holistic view of overall costs to the society: Costs & Benefits Analysis

In recommending huge addition to coal based, dam based and nuclear based power capacity IEP has completely ignored the true costs to the society of the implementation of such additions. Without an objective assessment of all direct and indirect costs of such conventional power plants to the society, including the inevitable impact on Global Warming the society cannot determine whether an individual project is more beneficial than true costs to the society. Without a rigorous economic analysis it is impossible to determine whether a coal based, OR dam based OR nuclear based power plant is most suitable in a given circumstance and in a given geographical location. Hence it is sad that the same is not being insisted for projects of such societal importance in prevailing approval process. It is even deplorable that IEP as a medium to long term policy document has not even discussed this crucial economic analysis tool.

As a developing country with huge poverty levels and aiming towards a welfare society, we need to be absolutely certain that every resource, every rupee spent brings maximum benefits to the whole society;

not to just to the project developer. Without a rigorous economic analysis how can we be sure that : (a) a nuclear power park proposed in Konkan coast will not cost many times more than the true ecological value of the environment/economy to be destroyed there; (b) the UMPP proposed in Krishnapatnam, Andhrapradesh, will bring in much more benefits to the local fishermen and farmers community than potential threat to their livelihood; (c) a cascade of dams on river Subansiri in Arunchala Pradesh will not result in more damages to the local economy than benefits etc.?

Only an objectively conducted Costs & Benefits Analysis (CBA) can provide satisfactory answer to such questions. CBA can be an effective mechanism to determine the least cost option for the society in a given situation. If deployed objectively it can capture all the direct and indirect costs and benefits to the society of a given project, and also can provide a realistic comparison of economic value of costs and benefits. Advanced countries, including USA, resort to such a rigorous economic analysis to determine the viability of power projects. This route if taken up logically will mandate the project developer to discuss all the credible options to achieve a given objective (let us say meeting the increased demand for electricity for a city); take 3 or 4 of the best options from this group of credible options; subject each of them to CBA; compare them; apply sensitivity analysis to the best two options; and then only submit the best option for approval along with the detailed explanation as to why the next best option/options are not considered. Such a CBA would entail all the direct and indirect costs to the society, include the sustainability option and any intangible costs and benefits.

The sensitivity analysis as an essential part of CBA will help to reduce the uncertainty of costs and benefits. In this analysis, the estimated costs and benefits can be increased by 5, 10 or 20% to see how various indicators such as Net Present Value (NPV), pay back period, Internal Rate of Return (IRR) or the ratio of benefits to cost will vary. As a much more vigorous analysis the costs are increased and the benefits are decreased at the same time to determine how credible a given option is. Sensitivity analysis in these options can reduce the uncertainty associated with costs and benefits. An objective comparison of all these options can provide the best option from the society's perspective.

There are people who believe that such CBA can be very subjective. But the very process, if made transparent and allowed public scrutiny, will bring out many issues to the fore, which all the stake holders can discuss and understand the importance of each such issue to the society. But in the absence of such a tool as of now, we cannot even discuss the same.

As a densely populated country with limited resources, our society needs all such credible analysis tools to be deployed objectively to choose a technology so as to get maximum benefit for the entire society, instead of blindly following business as usual scenario. It is tragic that IEP has not neither discussed this path.

Without the mandate to provide such a rigorous analysis the project developers, including the Public Sector Undertakings, are known to be proposing ill-conceived project proposals. It appears that every proposal of this nature is getting license to implement the project. One example of a hydel project can better illustrate the relevance of CBA mechanism in finding the best option amongst various alternatives available in a given situation:

Karnataka Power Corporation Limited (KPCL) has proposed a 400 MW Gundia hydel project in thick rain forests of Western Ghats. The benefit of this project is mentioned as certain quantity of electrical energy at a low annual load factor of about 35%. But the societal costs involved are huge. If an objective

CBA is applied to this situation, many other credible options can emerge: (1) can we get 400 MW equivalent from replacing all incandescent lamps in the state with CFLs ?; (2) can T&D loss reduction in the state from the present level of about 25% to 10% provide about 900 MW virtual additional capacity ?; (3) how much power can be generated by the bio-mass of the identified forest of the project on a sustainable and environmentally friendly manner ?; (4) how much savings in energy can be achieved if this project cost of about Rs. 2,400 Crores is deployed in energy efficiency and energy conservation measures within the state? All the associated costs and benefits of so many options can be rigorously analysed.
Even without a detailed analysis it is evident that the alternatives in this case have much better benefits to costs ratio. But in the absence of any legal mandate for such CBA, the project developer proposes only one option. In such a situation it is left to the civil society to undertake such CBA studies under a lot of constraints and oppose such ill-conceived projects.

A typical case study with high level of costs may exemplify the importance of comparing different options for meeting electricity demand (Annexure 10).

An oft repeated statement in IEP is that the capital cost of new and renewable energy sources is exorbitant. Without taking all the direct and indirect costs to the society in respective life-cycles of different projects based on conventional technology, comparison of these sources on capital cost basis only with renewable energy sources cannot be pragmatic. Whereas the coal, nuclear and dam based hydro power industries have enjoyed patronage in the form of many subsidies, tax holidays and freebies for a number of decades, the new and renewable energy sources have not had comparable patronage in even in the last 15-20 years of their true existence. The externalities of the conventional energy sources, such as social, health and environmental costs, which have been conveniently ignored in such comparison, if taken into objective account will clearly tilt the balance in favor of new and renewable energy sources. Additionally, since the fuel costs and O&M costs are negligible in case of new and renewable energy sources, if we compare the life cycle cost of the two technologies there will be no doubt as to which ones are better.

Whereas the capital, fuel and other operational costs of conventional energy sources are increasing every year, the capital costs of renewable energy sources are coming down rapidly because of technological innovations and material development. So much so that many international studies indicate that these costs will be comparable within few years, with necessary policy interventions. IEP has failed to do such an objective comparison.

IEP seem to indicate that our government has still not realized the grave energy crisis we are facing today and how it will worsen in the future in a business as usual scenario. Despite the huge subsidies spent on energy sources such as kerosene and electricity, poor people still have no access to a reliable and safe fuel/energy. It is still not recognized that most of the benefit of "free electricity" in agriculture sector is going to a small percentage of rich and middle class farmers.

10. Energy Needs of other Sectors of our economy: transportation and rural domestic cooking

With the import content of petroleum products expected to touch 85% soon there is a dire need for our society to find suitable alternatives to provide fuel for the transportation needs. For the developed

countries which are addicted to gasoline guzzling private vehicles transiting back to railways and public transportation is a Herculean task. But for a country like India it should be comparatively easy provided we do not allow the population to get addicted to private vehicles. Tata's much heralded Rs. One lakh car is totally against the need for responsible use of petroleum products. But the government is doing very little to avoid the future problem of petrol and diesel demand increasing rapidly. There should have been optimum policies for market to work so that public transportation is preferred over private.

It is not clear from IEP as to whether piped supply of gas for cooking purpose in cities, as being proposed by the gas companies, is sustainable. If a complex network of gas pipelines is laid in cities at huge cost to the society, can the gas supply be ensured on permanent basis without having to depend on imported gas?

In the background that about 500 vehicles are being added every day in cities like Delhi and Bangalore, unless the large number of private passenger vehicles are limited to manageable levels, the transportation sector will be a major drain on our economy, and also cause all the attendant problems.

Most of the cities and urban areas are already witnessing unbearable congestion of private vehicles on the roads. In cities like Bangalore, the average automobile speed is reported to be less than 15 kMPH, which is leading to a lot of inefficiency in fuel consumption, and is impacting the economy in the form of lost time in traffic jams. The demand for increase in the width of roads, number of road lanes, fly-overs, express ways etc. has a huge impact on the social and economic issues because the huge investment on these additional facilities are for the sake of a tiny percentage of the population having access to private vehicles, but for which the entire society is paying up in one way or the other. Explosion of vehicle population and the unending expansion of road network in cities are putting the interest of other sections of our society at risk; whether in usage of road space or in associated pollution or in the increased felling of avenue trees etc. Due to such a drastic increase in number of vehicles on the roads the accidents are increasing exponentially.

Reports indicate that about 80,000 to 100,000 road accidents are occurring every year out of which about 40,000 are fatal. This is a serious matter for the society and must not be ignored anymore. There is also an issue of social equity. Whereas a small percentage of population are owning motor vehicles, they are demanding and getting exorbitantly larger share of resources such as subsidized petrol/diesel, large road space etc. Whereas the rural areas are unable to secure even basic road infrastructure a lot of resources are being poured into creating urban road network.

The govt. should seriously consider these issues and undertake measures to control the number of vehicles on the road and the consumption of petroleum products at a manageable level. There is no escaping the fact that public transportation systems have to be improved on a massive scale and many incentives being provided to automobile sector should be reviewed objectively. Old and inefficient vehicles should be eliminated on a rigid time scale.

The investment in adequate development of railways should be taken up on a war footing. Since the electric locomotives are considered much more efficient, even diesel electric engines should be gradually phased out, and massive electrification of railway routes should be undertaken on a priority basis.

Serious consideration should be given to the option of encouraging battery run private passenger light vehicles, which can be charged by solar energy during day time. A substantial portion of various forms of subsidies which are being provided to motor industry should be diverted to R&D in this regard.

Another area requiring the attention of all the planning and implementing agencies is the energy needs of the rural India. With about 70% of the population still living in rural India, our society has largely ignored the energy needs of this vital section of our society. Unless the energy needs of rural areas are addressed satisfactorily, massive urban migration will continue unabated, and the multiple problems already being faced in urban areas will escalate.

It is sad that even the very modest energy needs of our villages have not been satisfactorily addressed after 6 decades of independence. As per IEP the benefit of massive investments in natural gas sector goes largely to urban areas with 44% urban households and only 5% rural households getting LPG (IEP: page 6). IEP also quotes estimation that about 96% of the rural households are still dependent on biomass energy (IEP: page 6). It appears that for the majority of the huge population in this resource constrained country, we cannot wish away the usage of biomass energy in the near future.

While the problems associated with supplying kerosene for cooking needs have remained insurmountable, attempting to supply LPG to rural households also is neither economical nor sustainable. The logical thing is to invest adequately to develop and supply efficient and affordable size Chulas, cooking stoves, and other heating/cooking appliances, and adequate technological/financial assistance to minimise the associated health impacts. Bio-gas plants such as gobar-gas plants also need to be encourages at individual houses or as community facilities to meet the cooking needs of the rural population. Many institutions like IISc, Bangalore have developed such appliances, but further investment is needed in these areas to make them popular.

Solar cookers also can play a major role in meeting the cooking needs of the rural population. Solar water heaters, as in the case of urban areas, can do away with the use of electricity and/or bio-mass for bathing purposes. Making bicycles much more affordable to rural population may be another option.

11. Good recommendations in IEP

IEP has made many good recommendations. Such major recommendations are:

- It has clearly recognized the need for, and huge potential savings in effective demand side management (DSM), and has strongly advocated some measures in that direction;
- Time of day metering; day light savings; energy audit for loads in excess of 1,000 kVA; energy efficiency standards and measures; improving PLF of thermal power plants; mandating only efficient steam boilers for coal power plants are all good recommendations;
- It has advocated for least cost planning and multiple resources to meet the energy demand; but it has not extended the logic to all segments of energy supply;
- There is a strong recommendation on providing some equity in energy availability to the poor by providing a minimum life line electricity of 30 Units per month per family free of cost;
- Clear recommendation to accurately measure electricity supplied to each consumer;
- Improved fuel efficiency for motorized vehicles and encouragement for hybrid vehicles;

- Has mooted the novel concept of Energy Service Companies (ESCO) for harnessing the huge potential in energy efficiency and DSM.
- Emphasis on R&D for developing new generation technologies; A National Energy Fund (NEF) has been recommended to finance energy R&D. These include coal technologies for efficiency improvement; in-situ gasification; Integrated Gasification Combined Cycle (IGCC) and carbon sequestration; solar technologies covering solar thermal and photovoltaics; bio-fuels such as bio-diesel and ethanol; bio-mass plantation and wood gasification, and community based bio-gas plants.
- Recommended new coal power plants with high efficient boilers only;
- Strong focus on expansion of railway electrification to reduce road transport;
- Recommendation for charging true cost of supply of energy;
- Recommends a consistent application of "Polluter Pays" and "Consumer Pays" Principle;
- Public sector autonomy to energy companies to ensure a commercial culture;
- Promotion of solar hot water systems and efficient lighting initiatives,
- Suitable compensation to the resource rich states for sharing their resources with other states.

12. Alternative Supply Options – moving towards sustainability

In view of the huge deleterious impacts of large conventional power plants on social, economic and environmental aspects of our society, sustainable alternative to meet the legitimate demand for electricity can be feasible only through an integrated energy resource management approach. Such an approach consists of deploying all the available options to meet the energy demand of the entire society at least societal cost. It includes effective demand side management (DSM), most efficient use of energy sources/services, optimum level of energy conservation and widespread use of new & renewable energy sources. The dependence on conventional energy sources should be gradually reduced until the new & renewable energy sources can effectively replace them, and should be targeted to be completely eliminated in the medium to long term.

In this context few statements associated with official agencies of the govt. would provide proper perspective.

The National Electricity Policy states: "It would have to be clearly recognized that Power Sector will remain unviable until T&D losses are brought down significantly and rapidly. A large number of States have been reporting losses of over 40% in the recent years. By any standards, these are unsustainable and imply a steady decline of power sector operations. Continuation of the present level of losses would not only pose a threat to the power sector operations but also jeopardize the growth prospects of the economy as a whole. No reforms can succeed in the midst of such large pilferages on a continuing basis."

"India's power sector is a leaking bucket; the holes deliberately crafted and the leaks carefully collected as economic rents by various stake holders that control the system. The logical thing to do would be to fix the bucket rather than to persistently emphasise shortages of power and forever make exaggerated estimates of future demand for power. Most initiatives in the power sector (IPPs and mega power projects) are nothing but ways of pouring more water into the bucket so that consistency and quantity of leaks are assured …."
Deepak S Parekh, Chairman, Infrastructure Development Finance Corporation, September 2004.

As the Bureau of Energy Efficiency has estimated, at the prevailing cost of additional energy generation, it costs a unit of energy about one fourth the cost to save than to produce it with new capacity.

IEP itself says: *"India's conventional energy reserves are limited and we must develop all available and economic alternatives. … Clearly over the next 25 years energy efficiency and conservation are the most important virtual energy supply sources that India possesses."*

IEP also estimates that CO_2 generated from energy use can be reduced by 35% through effective deployment of efficiency, DSM measures and renewables. IEP's main action recommendation for energy security is: "*… relentlessly pursue energy efficiency and energy conservation as the most important virtual source of domestic energy*".

As per IREDA, under the Ministry of Non-Conventional Energy (NCE) Sources:
"*Promotion of energy conservation and increased use of renewable energy sources should be the twin planks of sustainable energy policy*."

IEP itself has projected a total installed capacity based on renewable energy sources of 90,000 MW by 2031-32 consisting of 30,000 MW of wind power, 10, 000 MW of solar power, and 50,000 MW of bio-mass power.

New Zealand govt. had announced in 2007 the country's intent to increase the share of renewable energy from 70 % to 90% by 2025. European Union has a plan to meet 20% of all its energy needs by 2020 through renewable energy sources.
Israel is reported to be targeting 50% of its energy needs through renewable energy sources.
Norway has announced its plans to become carbon neutral by 2030.

Many agencies have come up with studies indicating techno-economically viable mixture of measures to meet global electricity needs during next 3-5 decades without having to add many conventional power plants. Many countries have not permitted coal power plant in recent years, and instead focused on solar and wind power. Spain and Germany are leading in harnessing solar and wind power. Being a tropical country India is endowed with huge potential in this sector, and has no reason not to focus heavily on renewables.

In 2009 the govt. has made a voluntary commitment to international community at Copenhagen to reduce its energy intensity between 20-25 % by year 2020. Of course one can say that this was not known when IEP document was finalized in 2006. But the huge potential for virtual capacity addition existing in the prevailing infrastructure is exemplified by this commitment.

Renewable energy, combined with efficiencies from the 'smart use' of energy, can deliver half of India's primary energy needs by 2050, according to the Greenpeace report: 'Energy [R]evolution: A sustainable Energy Outlook for India' (Annexure 11).

Another study by Earth Policy Institute, Washington had looked at ways and means of reducing the CO_2 emissions to contain Global Warming. This report says that the energy resources and the existing

technologies available throughout the world can reduce the reliance on fossil fuel drastically ("Time for Plan B: Cutting Carbon Emissions 80% by 2020" : Annexure 12).

What all these statements indicate is that there are credible ways of meeting the legitimate electricity demand of our country by environmentally and people friendly methods than through conventional energy sources such as fossil fuels or dam based hydro or nuclear power. India could be a leader in harnessing the same since our life style is congenial for low per capita energy consumption. Many countries around the world are resolutely moving towards such sustainable options, whereas our country has not been able to do enough even in optimally utilizing the existing energy infrastructure. What is inevitable in this regard is the urgent and concerted action plans at all levels by various organs of the STATE. Unfortunately IEP seem to have ignored the urgency to move towards this scenario.

12.1 Major Assumptions for projecting power demand/supply scenario in 2031-32

Focus areas for concerted action plans between now and 2032 should be: (i) take all credible measures to contain the demand of electricity to legitimate uses only which lead to largely economic and welfare activities; (ii) move resolutely towards ensuring efficiency to international best practice levels in all aspects of demand/supply and usage management; (iii) move away from the paradigm that fossil fuels are essential and that they will last for ever; (iv) make all possible efforts to shift lighter loads and non-essential loads to distributed type of renewable energy sources; (v) move towards a target date of replacing all conventional energy sources by renewable energy sources in the foreseeable future. In this regard the potential of renewable energy sources is proposed to be optimally harnessed, if necessary by consistent and persuasive policy interventions. Concerted efforts on a war footing are essential to move away from our overdependence on fossil fuels and inefficient methods.

The following action plans is considered essential in this regard.
I). A considerable portion of the increase in electricity demand between now and year 2032 is assumed to be met by the measures such as efficiency improvement, energy conservation and demand side management. There are many credible estimates which strongly suggest that about 30 - 40% of the present demand can be met by these measures, which would have made the existing scenario to be surplus by a considerable margin (table 8 below).

Electricity demand should largely be restricted for legitimate economic and welfare usage with minimum wastages in applications such as night time sports or decorative lighting etc. Peak hour demand is expected to be managed within 85-90% of the total generating capacity.

There will be huge emphasis to take the overall efficiency levels in generation, T&D, and utilisation towards the international best practices. It is expected that the T&D losses will not be above 10% in any part of the country, and that the PLF of no thermal power plants and nuclear power plants will be below 90%. Only energy efficient electrical appliances such as lighting devises pumps, motors, refrigerators, welding machines etc. will be in use by 2020.

Table 8: Power Sector Efficiency in India

Power Sector Area	Prevailing level of efficiency / loss in	Potential for improvement/savings

	India	(percentage of total annual energy)
Generating capacity utilisation	50 - 60%	5-10 %
Aggregate Technical & Commercial losses (AT&C)	35 – 40 %	15 -20%
End use efficiency in agriculture	45 – 50 %	15-20%
End use efficiency in industries and commerce	50 – 60 %	5 -10 %
End use efficiency in other areas (domestic, street lights and others)	40 – 50 %	5 -10 %
Demand Side Management	Potential to reduce the effective demand by more than 20%	

(Source: Estimation based on many reports/article on Indian Power Sector)

II). There have been studies to indicate that when the direct and indirect costs due to externalities (such as social, health and environmental costs) are built into the realistic cost of conventional sources, and when various subsidies are removed, the overall cost on life cycle basis will be more or less the same as that of renewable energy sources as of now. Greenpeace's *'Energy [R]evolution: A sustainable Energy Outlook for India'* (Annexure 11) has projected that with appropriate policy interventions the tariff for electricity produced by conventional power plants and by the new & renewables sources could be almost same by 2030. Hence adequate investments in deploying new & renewables sources are assumed to be undertaken between now and 2032 with this long term perspective.

III). It is assumed that all necessary measures will be taken to ensure that fossil fuel power plants, including coal power plants, reach peak capacity by 2020. Most of the existing thermal power plants and nuclear power plants would be expected to be decommissioned OR close to be decommissioned due to aging by 2032. Except for the already approved ones, most of the new coal power plants shall be basically to replace the old and inefficient plants, and shall be of highest possible overall efficiencies, which means they shall be of super critical boiler parameters only. Most of such power plants shall come on the existing site of the old and inefficient power plants to make use of the prevailing infrastructure and to reduce the acquisition of additional lands. In view of the heavy import component of petroleum products diesel power plants are expected to be completely absent by 2032. As per the projected power scenario by 2031-32 under this critique coal power capacity is projected to increase by 37% (with a share of 28% of the total capacity) as against IEP projection of 288% increase (with a share of 50% of the total).

IV). In view of new gas findings in K-G basin natural gas would be used optimally to reduce the reliance on coal power as a link energy resource until renewable energy sources are able to fully replace the fossil fuels; an increase from about 16,000 MW at present to 25,000 MW of gas based power is assumed by 2031-32.

V). Only small size (< 25 MW) dam based hydel stations shall be built strictly on run-of-river basis with a pond size catering to not more than 2 hours of water demand of the plant. Addition of 3,000 MW will take total hydel share from 25% at present to 10% by 2031-32.

VI). Percentage of nuclear power capacity is assumed to be only 3% by 2031-32 allowing doubling of capacity from the present level keeping in view the already committed projects. No nuclear power plant shall be built beyond 2020.

VII). Huge emphasis is assumed to be given to develop and harness renewable energy sources as the first option of energy source for each MW of additional demand. A substantial percentage of the renewable energy sources are expected to be distributed type such as roof top solar and community based bio-mass plants in order to minimise the additional land requirements and to reduce the T&D losses. Such distributed type energy sources will assist in accelerated rural electrification and reduce overall investment in power transmission and distribution network. Assuming about 30 crore house holds in the country by 2031-32 (@ 4 persons per house), and assuming that about 3 crore houses (10% of the total) in the country will be suitable and economically able to install roof-top solar photo voltaic systems of 2 kW each, about 60,000 MW installed capacity of solar power in distributed mode is feasible, and assumed to be fully utilised under this projection.

VIII). Additionally, the National Solar Mission has a target of adding 20,000 MW by 2020, most of which is assumed to be Concentrated Solar Power and grid interactive solar PV panels. With necessary policy initiatives this target is assumed to be ramped up to about 60,000 MW by 2032.

IX). The capacity of wind and bio-mass energy sources are projected keeping in view the potential as projected by IEP in its model, and on the basis that such a potential is for large size grid - interactive plants. These are expected to increase rapidly beyond 2032 to harness the off-shore wind mills and increase in energy plantations.

X). The energy consumption is projected to be measured accurately at various levels and at each consumer premises; tariff policy intervention is assumed to reduce the energy wastages and minimise the misuse of subsidies.

XI). The focus of the projection of installed capacity in this review is to consciously make attempts to gradually reduce the share of conventional power sources, including dam based hydel capacity, and to accelerate the addition of new and renewable energy capacity.

The techno-economically viable avenues to get the energy security are plenty. All it requires is a determined approach on a war footing.

Table 9: Break up of Projected Installed Capacity by 2031-32

	Capacity (MW)	**Share in total capacity by 2031-32**	**Comments**
Coal	110,000	28 %	Increase from present capacity of 80,000 MW; IEP has projected 270,000 MW
Hydro	40,000	10 %	Only < 25 MW capacity R-0-R plants only after 2032
Nuclear	10,000	3 %	Only known sources of domestic nuclear fuel to be used; targeted to be replaced fully by 2050
Natural Gas	25,000	6 %	Targeted to be replaced fully by 2050
Solar (Grid interactive large size units only)	60,000	15 %	National solar mission target of 20,000 MW by 2020 should be ramped up adequately
Solar (Roof-top isolated and Grid	60,000	15 %	Huge potential to be harnessed early by policy interventions; a must for accelerated rural electrification and

interactive small size units)			for T&D loss reduction
Wind	30,000	8 %	Same as projected by IEP; expected to increase share after 2032 through off-shore wind farms
Bio-mass	50,000	13 %	Same as projected by IEP; mostly community based plants
Other renewables (Ocean energy and Geo-thermal)	7,000	2 %	Nascent technologies but huge potential; likely to get better focus after 2032
Total Capacity	**390,000**		

12.2 Power sector scenario beyond 2031-32

- Electricity demand growth will be governed by diligent use of electricity for strictly economic and legitimate welfare uses only. Wastages will be heavily discouraged;
- Every power plant will operate at most optimal level of efficiency;
- Fossil fuel power plants, including nuclear power plants, will be completely eliminated by 2050;
- A substantial percentage of the energy sources are expected to be distributed type such as roof top solar and community based bio-mass plants OR hybrids of wind/solar/bio-mass;
- Agricultural/forest lands will not be diverted for energy related uses;
- Efficiency at all stages of energy management will be at international best practice levels;
- Energy tariff will reflect the true cost to the society; it will strongly discourage wastage and reward efficiency; vulnerable sections of the society will be provided life line energy at affordable prices;
- Huge emphasis will be given for continuous innovation in making energy sector more and more efficient, and less and less polluting;
- Every consumer of electricity will be encouraged to generate as much of electrical energy as possible by himself through initiatives such as roof top solar or roof top hybrids or to participate in community based power plants;
- Every industrial or commercial consumer will be encouraged/mandate to install roof top solar PV systems to meet atleast the lighting energy demand;
- Suitable feed-in-tariff mechanism for roof-top energy systems will be a common market tool to encourage local level energy production.
- CBA will be deployed as a mandatory and effective tool to eliminate inefficient and costly energy sources.
- Old hydel power plants with dams will be decommissioned carefully with adequate consultation with all stake holders.

What is clear from all these discussions is that certainly there are techno-economically viable means of satisfactorily meeting the legitimate demand for electricity without having to deploy additional conventional capacity on a massive scale, as projected by IEP. The effective demand on the electricity grid at present can be brought down considerably by time tested methodologies at a much lower cost to the society. Effective deployment of renewable energy sources can gradually reduce the reliance on conventional energy sources.

In this context it is perplexing that IEP has ignored the related issues and projected a massive increase to additional conventional capacity by 2031-32 at enormous cost to the society. The tiny

sections of the society, which are likely to benefit most from such projection, can only be the private corporations, but all the costs will be borne by the society. There is an inescapable need for the government to objectively review the energy policy as enunciated in IEP through effective consultation with the civil society, and to come up with the necessary action plans to protect the interests of the weaker sections, the bio-diversity and the environment.

13. Action Plan for a sustainable energy policy

These are in addition to good recommendations made by IEP listed in section 8 of this critique, and in modification of some of them.

a. The vision of IEP says: "To reliably meet the (energy) demand at competitive prices". A better vision should focus on realistic price and sustainability. Such a vision could be: *To develop an integrated policy to enable meeting the legitimate demand of energy for all sections of the society at realistic prices on a sustainable basis without compromising the interest of other aspects of the society such as flora, fauna and general environment.*

b. An objective consideration of welfare of all sections of the society with a definitive obligation towards the bio-diversity and environment must be the platform on which energy policy should be built on;

c. The last man on the street OR the vulnerable sections of the society should be at the centre of our energy policy to enable adequate human development of the entire society, instead of focusing on GDP centric development;

d. Energy security should not be viewed as something achievable by relying on external resources; it should be almost entirely on our own resources and our own strengths;

e. Energy/ electricity demand should be managed in such a way that its consumption leads to real developmental activities, and not lead to plundering of our natural resources by wasteful and/ or luxurious applications; a clear distinction between electricity needs, wants and luxury should be arrived at by the society;

f. Energy/ electricity should not be made available at cheap rates; there cannot be any competitive rates either; it should be available only at the true cost of supply, and should be available only through the most efficient mechanism/ process operated on a sustainable basis;

g. The requirement to develop an integrated energy policy was a golden opportunity for the Planning Commission to set right the wrong priorities adopted in the policies since independence. The recommendations should have included specific action plans with stiff targets and accountability;

h. In view of the huge impact on our society, including the all important environment, the use of non-renewable energy sources, such as coal, natural gas and nuclear, should be discontinued at the earliest; their usage should peak by 2020, and gradually eliminated latest by 2050;

i. In view of the inevitability of harnessing the renewable energy sources on a sustainable basis, all out efforts should be made to develop them to meet our entire energy needs by the middle of this century; this should include adequate focus on R&D, fiscal incentives if necessary, suitable policy interventions, necessary regulatory measures etc.;

j. International best practice level efficiencies must be adopted at all stages of energy cycle; AT&C losses should be brought down below 10% in each revenue district of the country by 2020;

the PLF of each coal /nuclear power project should be improved to a minimum of 90% by 2020; efficiency of end use applications, including agricultural pump sets should be comparable with the international best practices by 2020; electricity revenue recovery rate in each state should be improved to a minimum of 95% by 2020;

k. The Central power utilities such as NTPC, NHPC, PGCIL, NPC etc. should be mandated to invest about 10 - 20% of their annual budget in modernizing the transmission and distribution system in each state so as to reduce the AT&C losses below 10% by 2020; adequate return on such investments should be ensured;

l. The Central generating agencies such as NTPC, NHPC and DVC should be encouraged to invest about 10 - 20% of their annual budget in the modernization of old and inefficient power plants in state sector, either by acquiring such assets or as an investment on easy terms;

m. Without an effective Costs and Benefits Analysis (CBA), along with a societal perspective, no new power plant should be deployed;

n. By 2015 every coal power plant with PLF less than 60% and/ or older than 20 years should be either be undergoing complete renovation or complete replacement by efficient power plants;

o. Most of the newly permitted coal power plants should come up on the sites of existing old/ inefficient power plants;

p. By 2020 atleast 10% of domestic consumers of electricity should have roof top solar or roof top hybrids for electricity generation, or should be participating effectively in community based power plants;

q. By 2020 atleast 50% of industrial or commercial consumers should be encouraged/ mandated to install roof-top solar PV systems to meet atleast the lighting energy demand;

r. By 2020 atleast 50% of educational institutions and govt. buildings should be encouraged/mandated to install roof-top solar PV systems to meet the lighting energy demand;

s. By 2020 atleast 10% of the villages in the country should have their own electricity supply system based on solar, wind and bio-mass sources of adequate capacity to meet most of their demands including agricultural demand, either in isolated mode or in grid interactive mode;

t. A national fund should invest adequately to reduce the agricultural pump set losses from the present level of about 50 % to 10 % by 2015; newly created ESCOs may be entrusted with such responsibility;

u. The carbon tax on coal usage should be increased gradually from Rs. 50 a ton at present to Rs. 500 a ton by 2020 to develop a fund to encourage popularization of distributed renewable energy sources;

v. By 2013 an effective feed-in-tariff mechanism for roof-top energy systems and community based renewable energy systems should be in place to encourage local level energy production;

w. By 2020 atleast 25% of industrial /commercial establishments with heating requirements should be using solar energy for this purpose;

x. A suitably designed pollution tax should be applied to each litre of diesel, mega litre of water or kWH of energy produced/consumed/generated by 2015; suitable incentive also should be admissible for exceeding the targets of reduction in pollution and efficiency in energy generation.

y. The available option of revenue earning through Clean Development Mechanism (CDM) in cases of green alternatives to conventional power generations should be optimally used.

z. All feasible options available to flatten the electricity demand curve in each state should be deployed, and the difference between maximum demand and average demand should be reduced to, say, 10% by 2015 in all the states; no new peak load power stations, such as pumped storage plants, should be permitted with immediate effect; Time of Day (TOD) metering with suitable tariff regime to differentiate between peak hour tariff and lean hour tariff should become compulsory for all loads above, say 10 kW by 2015. There should be an incentive to bring the lower capacity consumers into this regime.

aa. Energy metering must be made compulsory for each consumer and there shall be no supply to any consumer without accurate metering beyond 2015;

bb. It will be highly desirable for the Planning Commission to initiate the necessary action to commission an independent expert group to make an objective cost-and-benefit assessment study on all the existing large dam based and coal/diesel/gas based thermal power projects. The group should assess whether these projects have delivered the desired benefits, as also their socio-economic-environmental impact on the local community. The compiled report should be published and studied so as to reach a final conclusion as to whether such projects have proved to be in the interest of the society, so that the concerns in this regard are satisfactorily addressed satisfactorily by 2020;

cc. Initiate action plan to mandate effective public consultation at the stage of the application for registration itself on all large projects. All the concerned stake holders should be able to participate in such consultations, and arrive at the correct decision regarding the benefits of the project and agree on the process of comprehensive rehabilitation. All the concerned stake holders like the locals and NGO groups, should be involved from the initial stages of project conceptualization. Such pro-active action will reduce the chances of public opposition to approved projects and corresponding project completion delays;

dd. All feasible options available for increasing the capacity or to improve the efficiency of each of the existing generating stations should be explored and implemented. In this regard CEA should be asked to look at each of the stations state by state, consult the original equipment manufacturers or experts to determine the opportunity available. In such situations, the actual cost of such improvement process, however high, will turn out to be far less than the cost of building new power stations. But the contractor should provide specific guarantees and the results should be measurable and accountable. The PFC could be asked to finance the costs, and NHPC/NTPC should manage the projects;

ee. Develop (if necessary, borrow the ideas already developed in advanced countries) and implement the concept of peer review of all the projects and work processes in each of the state owned electricity undertakings; effective stake holder consultations should be a part of mandatory approval process;

ff. Undertake comparative studies in detail of the electricity industry performance in our country with those in developed countries; publish the Key Performance Indicators (personnel per MW handled, overall efficiency, project implementation time etc.) in those countries, and set realistic but stiff annual targets for our own industry, to be achieved by 2020 to attain a comparable level of industry efficiency;

gg. The proposed ultra mega power projects of 4,000 MW capacity each in green sites are not in the overall interest of our society, and hence should not be considered further. Instead the more

sensible option of considering the existing sites of older and low PLF thermal power stations should be used. Such sites should be used to install new super critical technology units of 600/800/1000 MW capacity, and to improve the average PLF to more than 90%. If necessary, entirely new station should be considered on the old sites to reduce the need for acquisition of additional lands.

hh. Ecologically sensitive areas like the bio-diversity rich Western Ghats and West coast, Eastern Ghats and East cost, Himalayas, and other forested areas must not be considered for any power generation/transmission related projects.

ii. The usage of CFL/LEDs should be fully implemented by 2015 by: (a) following the example of Maharastra, where the electricity companies are providing millions of such lamps to house holds on easy payment terms; (b) provide tax benefits/subsidy for the manufacture of CFLs/LEDs for few years; (c) directly & indirectly discouraging the usage of incandescent lamps by levying cess on their sales; (d) by banning the sale of incandescent lamps by 2015; (e) undertake few projects under CDM to finance the subsidy on CFLs/LEDs.

jj. The role of CEA should be reviewed and necessary changes should be brought about to make it's role more people oriented and objective. It should pro-actively interact with electricity companies and the public very frequently on all related issues; conduct state-wise/ region-wise seminars to keep itself up to date with the ground realities; be more sensitive to the environmental and social issues in site selection process etc. In essence it should be an authority in all aspects of the electricity industry correctly reflecting the needs of the people and bringing the world best practices to India. Instead of being a Delhi based theoretical organization it should become down to earth, people oriented and practical organization. Its staff should be encouraged to gain work experience in generating stations, transmission and distribution systems, and to freely express their opinion on technical and economic issues related to all aspect of electricity industry.

kk. Time bound action plan to formulate legislation for creating two or three time zones for the country should be initiated.

ll. Subsidized electricity to any category of consumers should be only by advance payment of one year's subsidy amount by the concerned state government.

mm. A comprehensive policy to encourage widespread usage of pubic transport systems should be implemented; usage of private vehicles should be discouraged keeping in view the huge cost of fuel imports and the pollution impacts; old and inefficient vehicles should be eliminated on a rigid time scale; adequate investment in railways should be taken up on a war footing.

nn. Rain water harvesting should be implemented as a major initiative in managing the demand for electricity and also for water security.

oo. For all future hydel projects a minimum of river flow called ecological flow should be mandated at every point on the river; this quantity should be arrived at by effective consultation with all the stakeholders.

pp. Public sector autonomy to energy companies to ensure a commercial culture should be mandated by 2015;

ANNEXURES

Annexure: 1

Urban-Rural Discrimination in Electricity Supply

The author, who lives in a village of about 200 houses in Karnataka, experiences such electricity discrimination every day. This village is scheduled to get power supply for 12 hours a day for domestic purpose, but the unscheduled power cuts and other interruptions for maintenance purposes bring this duration down to less than 10 hours a day on an average. On many days the supply situation becomes so bad that even the UPS (Un-interrupted Power Supply) system cannot get sufficiently charged to provide the necessary back up supply for lighting system. The rural feeder at 11,000 Volts which brings supply to the village, like most rural feeders in Karnataka and probably everywhere in the country, is so much neglected that simple devices like lightening arresters are not installed to protect them from lightning surges. The consequence of this neglect is that the sub-station which controls this feeder at Thirthahally town switches it off manually whenever there is an indication of lightning. Being a part of Western Ghats, which receives heavy rainfall during monsoon season, the village is subjected to many such interruptions in a single day, especially during monsoon season. In addition to this there are other types of interruptions which make the electricity supply a farce. Though this village is only 4.5km from the Taluk Head Quarters (Thirthahally) it gets much less power supply than the Taluk Headquarters itself. This situation in Karnataka, where the state capital gets the best quality of supply, and the power quality deteriorates as we go down pop-strata, seems to apply to the rest of the country as well.

Annexure: 2

Clean Coal Technology

(Source: Wikipeadia)

Clean coal technology usually aims to address only the atmospheric problems resulting from burning coal. But the pollutants emanating from coal burning cannot be eliminated, and hence have to be managed adequately. Concerns exist regarding the economic viability of these technologies and the timeframe of delivery, potentially high hidden economic costs in terms of social and environmental damage, and the costs and viability of disposing of removed carbon and other toxic matter. More, the byproducts of coal power production range from fly ash sludge ponds full of mercury, arsenic, and sulfur in unlined ponds that can leak into the water supply. The coal industry has tried to address the concerns by running advertising touting clean coal in an effort to counter negative perceptions, as well as by putting more than $50 billion towards the development and deployment of clean coal technologies, including carbon capture and storage. The expenditure has been unsuccessful to date in that there is not a single commercial scale coal fired power station in the US that captures and stores more than token amounts of CO_2. The world's first "clean coal" power plant went on-line in September 2008 in Spremberg, Germany. The plant is state owned because of the high costs of this technology. The facility captures CO_2 and acid rain producing sulfides, separates them, and compresses the CO_2 into a liquid state. Plans are to inject the CO_2 into depleted natural gas fields or other geological formations. Some of the largest concerns of this technology are: huge cost implications; an estimated additional energy requirement of about 33% in running the associated processes; uncertainty of keeping the pollutants, including CO_2, deep underground. Some of the techniques that would be used to accomplish lean coal include chemically washing minerals and impurities from the coal, gasification, treating the flue gases with steam to remove sulfur dioxide, carbon capture and storage technologies to capture the carbon dioxide from the flue gas and dewatering lower rank coals (brown coals) to improve the calorific value, and thus the efficiency of the conversion into electricity.

Annexure: 3

Coal Secrets of China

Business Week report in August 2005 says: "…. most of China's electricity comes from coal power plants but lack effective emissions controls, acid rain falls on one-third of the country. .. Six of the world's 10 most-polluted cities are in China, according to the World Bank, which estimates that pollution costs China more than $54 billion a year in environmental damage and health problems. China's soaring energy use and resulting pollution are a serious threat to the country's continued prosperity and growth, not to mention the well-being of its citizens. China has spent more than $85 billion on environmental cleanup in the last five years and could shell out $380 billion -- 4% of gross domestic product -- between now and 2010. But even those outlays aren't enough to offset the pollution generated by the country's annual growth rate of more than 8%. The problems are compounded by China's inefficient use of electricity, oil, and coal."

Annexure: 4

Coal's Assault on Human Health

(Source: Physicians for Social Responsibility, USA)
(http://www.psr.org/assets/pdfs/coals-assault-executive.pdf)

A report of 2009 by the title "Coal's Assault on Human Health" by Physicians for Social Responsibility has elaborately discussed three major categories of human health problems from coal burning. On the vast experience of coal power production in USA this report unambiguously associates many health issues under each category of Respiratory, Cardio-vascular and Neurological problems to coal burning. The report specifically warns of the danger in escalation of complaints of asthma, heart disease and stroke. Some of the major recommendations of the report are: (a) emission of CO_2 should be cut as deeply and as swiftly as possible; (b) there should be no new construction of coal power plants; (c) US should dramatically reduce fossil fuel power plant emission of Sulphur-di-Oxide and Nitrogen Oxides; (d) US must develop its capacity to generate its electricity from clean, safe and renewable energy sources so that existing coal power stations may be phased out.

Annexure: 4A

Despite Rhetoric, World Bank Fossil Fuel Projects Do Not Contribute to Energy Access

Washington, DC – A new report by Oil Change International, released on the eve of the World Bank's Annual Meetings, dispels the myth that World Bank support for coal and oil projects increases access to energy for the world's poorest. This finding stands in contrast to government, Bank, and industry claims that ongoing taxpayer support for these large coal and oil projects is necessary to alleviate energy poverty.

The World Bank has used arguments around increasing energy access – providing energy to the 1.4 billion people who lack access to electricity or the 2.7 billion still using wood or biomass for cooking and heating – to justify the approval of massive new coal-fired power plants like the Eskom plant in South Africa, as well as the continued funding of oil projects. But both Oil Change International's original research and the Bank's own analysis show that none of the Bank's coal or oil lending for the last two years have prioritized increasing energy access.

"World Bank officials justify massively polluting coal and oil projects by saying that they increase energy access for the poor – but that's just not true", said Elizabeth Bast of Oil Change International. "Our analysis and the World Bank's are remarkably similar. Energy from the World Bank's coal and oil plants go to support big industry, not the world's poorest."

"Once again, the research bears out that the world's poor do not benefit from fossil fuel projects," said Bast. "Not only do the poor suffer the climate impacts of increased fossil fuel emissions and impacts from local pollution, but they are also not receiving the energy from the same projects that damage their livelihoods. With so many in the world without energy, the World Bank must prioritize investments that ensure increased energy access for the poor instead of prioritizing fossil fuel projects for industrial use."

Some key findings from the report, World Bank Group Energy Financing: Energy for the Poor?:

- *None of the 26 fossil fuel projects reviewed clearly identify access for the poor as a direct target of the project.*
- *The World Bank Group and the report authors agree that no coal or oil projects can be classified as improving energy access for the poor.*
- *In FY2009 and FY2010, funding for upstream fossil fuel projects and fossil fuel power plants dwarfed World Bank spending on access projects by 225 percent or $7.2 billion compared to $3.2 billion for access (according to the Bank's own assessment, which includes two questionable gas projects).*

Annexure: 5

Costs and Benefits Analysis - Kotlibhel 1B hydel project

(Source: "Economics of Hydro Power" - Dr. Bharath Jhunjhunwala, Kalpaz Publications)

In a detailed study of costs and benefits of Kotlibhel 1B hydel project in Uttarakhand, Dr. Bharath Jhunjhunwala has meticulously listed a large number of costs to the society. While the project developer (NHPC) of Kotlibhel 1B hydel project has listed the benefits as (i) benefits from generation of power, (ii) 12% free power to State, (iii) employment, lot more costs to the society have been highlighted in this Costs and Benefits Analysis (CBA). Even the benefits mentioned in DPR as prepared by the project developer are not all for Uttarakhand because the additional employment so created will not go to the people of the state alone. It is very important to note that the total benefit and cost of Kotlibhel 1B HEP in this CBA are calculated as Rs.155.5 Crores, and Rs.931.8 Crores respectively, because of which the resultant economic value of the project can be a net loss of Rs. 776.3 Crores to Uttarakhand and the country. It will be unrealistic to expect the project developer to accept these calculations, but the actual costs to the society can be even higher. Even though different values may be assigned to various costs listed in this CBA by different schools of thinking it is very prudent to consider the magnitude of order in the costs and benefits. Even the staunchest proponent of dam based power projects will find it difficult to support a project which can be associated with a loss to the society of about 6 times that of the benefits. Even if the estimated losses are assumed as only 25% of the indicated value, the costs to benefit ratio will still be 3/2. Such are the costs and benefits to the society of large dam based projects.

Annexure: 6

Costs and Benefits Analysis - Bedthi hydel project

(Source: IISc Website)

One of the first exercises to study in detail the effect of a project on the environment and to develop an economic model imbedding ecological costs has been the study of the Bedthi Hydroelectric Project proposed in Uttara Kannada district of Karnataka in 1980s. This project, proposed across river Bedthi and designed for producing a total of 210 MW, was shelved on the grounds that the economic value of r the biomass generated by the local forest identified for submergence by the dm waters was more than the energy equivalent of the proposed project. It is very pertinent to note that the state government was convinced that economically the project was not a viable one after it was cleared by the Central Government and after all the clearances had been obtained. This project was looked at from economic, ecological and other angles by the scientists from Centre for Ecological Sciences, IISc and other places like IIM (Bangalore), Pune, Calcutta as well as by reputed ecologists and local farming and forestry experts. This study indicated that if realistic cost for forest revenue, agricultural yields, grass and firewood are included in the calculations, benefit to cost ratio comes down to 0.847 from 1.5. If energy storage aspects were to be compared, the project would have produced 1 MW for 50 hectares, whereas the local forests could generate biomass with energy equivalent of 1 MW of power with 25.50 hectares. This clearly illustrated that energy lost could have been more than the energy gained if the project were to be commissioned.

Annexure: 6A

Floodwaters welcomed in Indus delta *(The Hindu - 07 October 2010)*

The Hindu reports that the recent floods in Indus, Pakistan has brought joy and hope for those at the mouth of the Indus river whereas it has caused destruction elsewhere.

The curse of the rest of Pakistan has been a blessing for the Indus delta, a maze of mangroves and shabby fishing villages at the mouth of the 3,000-kilometre river. Here, the fresh water that ravaged the rest of the country is bringing new life and renewal.

Fishermen report an abundance of fish. Catches are up 20 per cent in the last month, and could rise another 50 per cent as the season progressed.

Perhaps more significantly, the floods have brought an ecological windfall. Decades of building irrigation and hydro-electric dams further up the Indus drained the river of its force, allowing salty fresh water to infiltrate the delta. Mangrove plants on the mudflats perished — the acreage was halved between the 1950s and 2009 — while nearby farming land became uncultivable.

Now the swell of fresh water — known locally as " mithi", or sweet water — has injected new life into the sagging ecosystem. The provincial government says the mangroves are growing again as the salt water is pushed back.

A revitalised delta could, in time, turn marshes into agricultural land and herald a return of birds and other wildlife. Keti Bunder, a shabby little port that has been slowly dying over the years, could be revived.

Annexure: 7

BankTrack calls on banks to stop funding nuclear power

Nijmegen, May 26 2010 – BankTrack, in cooperation with a number of working partners, today launches www.nuclearbanks.org, a new website mapping the involvement of 45 leading commercial banks in funding nuclear power projects and companies active in the nuclear sector.

BankTrack considers nuclear energy a grave danger for people and planet. The renewed interest in nuclear energy also poses a severe obstacle to achieving a sustainable solution to the climate crisis -----

"Nuclear power covers only a few percent of world energy needs, but it poses massive environmental, health and security hazards. Building more reactors would also be a dangerous waste of time in global efforts to combat climate change: emissions of greenhouse gases have to peak and then significantly decrease in the next ten years, while reactors take a decade or longer to build. Time and resources must instead be used for implementation of renewable energy and energy efficiency measures. In many countries, nuclear policy has become an obstacle to finding effective solutions to the climate crisis and achieving energy security" said Jan Beránek, nuclear energy project leader of Greenpeace International.

"Too many well known banks that otherwise have taken laudable steps towards sustainability, are still investing heavily in the nuclear industry, putting the world on the wrong energy track. Sustainable banking and financing nuclear energy are simply incompatible" said Johan Frijns, BankTrack coordinator.

"Banks need to wake up to the fact that nuclear energy is extremely unpopular with the wider public. For example, a March 2010 European Commission survey found that 52 percent of Europeans consider nuclear power to be a risk for themselves and their families, with only 17 % in favor of increasing the use of nuclear energy. This shows that bank support for this dangerous and dirty form of energy will in the long run alienate many of their customers", said Heffa Schuecking of urgewald in Germany.

Annexure: 7A

"197 suicides and 1,733 deaths at India's nuclear establishments in last 15 yrs"

In an article by rediff NEWS at rediff.com on 4th October 2010 under the above title, it was mentioned that "197 employees belonging to a number of nuclear establishments and related institutes in India have committed suicide and 1,733 scientists and employees belonging to these centres have died of illnesses like multiple organ failure, lung cancer, cirrhosis of liver etc, as per a report compiled by Mumbai-based RTI activist Chetan Kothari**."** *"The report based on 175 pages of documents sourced through 32 nuclear facilicties also reveal that 1,733 employees and scientists from these establishments died due to various illnesses that include cardiac strokes, liver failure, multiple organ failure, tuberculosis, cardio-respiratory diseases, lung cancer, septicemia, cirrhosis of liver, cerebro-vascular dieseases, chronic obstructive pulmonary diseases, mellitus etc amongst a host of other diseases."*

"The data has been sourced from the Nuclear Power Corporation of India in Mumbai, Bhabha Atomic Research Centre, Tata Memorial Hospital, Department of Atomic Energy, Atomic Energy Rgulatory Board, Saha Institute of Nuclear Physics (Kolkata [Images]), Uranium Corporation of India (Jharkhand), Nuclear Fuel Complex

(Hyderabad), Indira Gandhi [Images] Centre for Atomic Research, Environmental and Industrial safety (Kalpakkam, Tamil Nadu), The Institute fo Mathematical Sciences (Chennai), Department fo Atomic Energy, Heavy Watyer Plant (Tuticorin), Harish Chandra Research Institute (Allahabad), Institute for Plasma Research Centre (Gandhinagar), Institute of Physics (Bhubaneshwar), Heavy Water Plant in Kota (Rajasthan [Images]), Heavy water Pklant, Talcher (Orissa), Raja Ramanna Centre for Advaced Technology (Indore) amongst several others."

Annexure: 8

Vidarbha region to become hot bed of coal power projects ?

(Source: Business Standard of 24 May 2010)

A proposal of setting up 47 new thermal power plants in the backward Vidarbha region of Maharashtra has met stiff resistance from various quarters as it will use up large portion of water in nearby rivers, which have almost dried up due to poor monsoon last year (2009). The proposed generation units will adversely impact the farming community due to huge water consumption from existing water bodies.

The Chandrapur Super Thermal Power Station (CSTPS), which has a total installed capacity of 2,340 MW including 210x4 and 500x3 units, has been facing severe water crisis and six of its power generating units --- three units of 210 MW and three units of 500 MW --- have been closed down due to scanty rainfall last year and non-availability of water from Irai river …….

Maharashtra Water Resources minister, Laxmanrao Dhoble during his recent visit had already warned that 60 pc of the existing power plants will suffer due to water scarcity. Meanwhile, former Union Minister and Nagpur Congress MP, Vilas Muttemwar has taken up the issue of proposed new units in Vidarbha. In a letter to Prime Minister Manmohan Singh recently, Muttemwar pointed out that the Maharashtra government has assured 471.18 Million Cubic Metres of water to the new plants from dam reservoirs, lakes and tanks, obviously by diverting the supply meant for irrigation. Vidarbha is already facing acute shortage of water. Due to lack of irrigation and poor financial plight of farmers, the region has witnessed 40,000 suicides from 1997-2009, Muttemwar said. Also, pollution is a great problem in the region with Chandrapur occupying the third position in the country. Commissioning of more coal fired power plants will not only aggravate the already existing problem, but will also ruin the rich forest cover, he said. The proposal for addition of 20,000 MW power generation by 47 companies is bound to create multiple problems, the minister said in the letter.

"I hence request you to evolve a policy of restricting the concentration of coal based power plants in one particular region to avoid water scarcity, pollution and health hazards." He has sought a direction to the state government to restrict the number of power plants in Vidarbha region. Further, Muttemwar raised the issue in Lok Sabha recently under rule 377 and drew the attention of the government towards it.

Annexure: 9

Coal-based power plants pollute most

(Source: Magazine "Down To Earth", Dec 12, 2008)

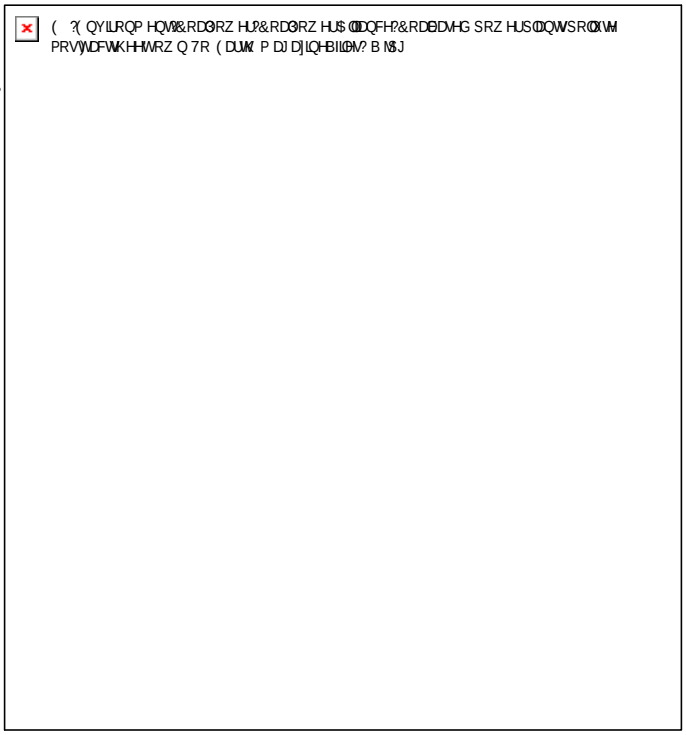
□ *The total installed capacity of the power sector in India is around 128,000 MW. Thermal power plants—using coal, gas or oil—together account for more than 65.6 per cent of the total power capacity in the country*

□ *Historically, the Indian power sector has been dominated by coal as the predominant fuel source of power, accounting for 82.45 per cent of the installed capacity followed by gas (16.12 per cent) and oil (1.43 per cent)*

□ *India has emerged as the fifth largest power market in the world. It ranked eighth in the last decade*

□ *The installed capacity in the sector has increased by more than 70 times from 1,713 MW in 1950 to 128,000 MW in 2007. The National Thermal Power Corporation is India's largest thermal power generating company*

□ *According to the power ministry, by 2012, the projected installed capacity of power will be around 207,000 MW, of which around 69 per cent will be contributed by thermal power plants, followed by hydropower (26 per cent) and nuclear (5 per cent). The ministry has also indicated it will double the capacity every 10 years*



□ *The western region has the largest share of the installed capacity in coal-based power plants (30.91 per cent), followed by the northern region (25.9 per cent), the southern region (23.3 per cent), the eastern region (19.3 per cent) and the north-eastern region (0.48 per cent)*

□ *Among thermal-based power generation sources, coal-based power plants rank highest in air pollution, waste generation and water consumption. It is also the largest emitter of carbon dioxide, a greenhouse gas*

□ *A typical 500 MW thermal power plant using coal emits around 105 tonne per day (TPD) of SO_2 (at 100 per cent load factor, 0.7 per cent sulphur content in coal), 24 TPD of NO_2 and 2.5 TPD of particulate matter (at 34 per cent ash content, 99.9 per cent electrostatic precipitator efficiency) and ash around 3,000-3,500 TPD. Moreover, disposing one tonne of flyash requires around 1 sq m of land*

□ *Indian thermal power plants consume on an average 80 cubic metre (m) of water for every MW-hour (MWh), while the global best practice is just 10 cubic m/MWh*

□ *Coal-based power plants are one of largest emitters of elemental mercury. On an average, Indian coal-based power plants release around 63 tonnes of mercury every year (assuming 0.25 ppm of mercury content in the Indian coal)*

□ *Except for particulate emissions, there are no formal standards for SO_2, NOx and mercury emissions in coal-based power plants*

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Annexure: 10

A case study to demonstrate the relevance of CBA

Case: An identified need for 1,500 MW of additional demand in Karnataka

Option I*: Karnataka opts for a 1,500 MW coal based power plant*

COSTS ***:*** *Direct Financial Cost : About 10,000 Crores (including transmission line)*
Societal Costs + tax incentives

- *Cost of about 1,500 acres of low fertile/fertile agricultural land*
- *Cost displacement of people*
- *Cost perpetual loss of agricultural production*
- *Cost about 1 TMC of water; denial of the same to locals*
- *Infrastructure cost to supply coal*
- *Cost of Air, water and land pollution + Global Warming*
- *Health costs: respiratory and neurological*
- *Cost of social unrest & economic deprivation of poor people*

BENEFITS :

- *About 1,500 MW power*
- *Employment for about 200 people (?),*
- *Dividend to state govt.*

Option II: *Integrated Energy Management Approach*

COSTS:

- *T&D loss reduction - 600 MW >> 900 Crores*
- *Utilisation loss reduction / DSM - 600 MW >> 900 Crores*
- *Wind energy - 100 MW >> 500 Crores*
- *Biomass – 50 MW >> 150 Crores*
- *Solar – Water heating – 100 MW >> 400 Crores*
- *Solar –residential lighting – 50 MW >> 1,500 Crores*

Total cost (a high level approx. cost) >> 4,350 Crores

BENEFITS:

- *Negligible societal cost; negligible or nil land and displacement*
- *No recurring costs such as coal, water and chemicals*
- *Negligible or nil health or environmental costs*
- *Reduced T& D losses; reduced man power costs*
- *Boost to agricultural and rural employment*

Annexure: 11

Greenpeace announces comprehensive energy strategy for India

(Source: www.greenpeaceindia.org)

Renewable energy, combined with efficiencies from the 'smart use' of energy, can deliver half of India's primary energy needs by 2050, according to the report: 'Energy [R]evolution: A sustainable Energy Outlook for India'. Commissioned by the European Renewable Energy Council (EREC) and Greenpeace it provides a practical blueprint for reducing India's carbon dioxide emissions by 4% in the next 43 years while providing a secure, affordable energy supply. According to the report, the contribution of renewables to the electricity mix needs to be gradually increased from the current 4% to 10% by 2010, 20% by 2020, and 65% by 2050. At the same time energy consumption has to be decreased by implementing energy efficiency measures. Inefficient lighting and other means of wasteful electricity consumption need to be phased out. A Renewable Energy Law needs to be passed creating incentives to stop using coal and oil and invest in renewables instead. It concludes that renewable energies will constitute the backbone of India's economy. More than 30 scientists and engineers from universities, institutes and the renewable energy industry around the world collaborated to provide detailed regional assessments for the future potential for renewable energy sources and energy efficiency measures. The Energy [R]evolution Scenario describes a development pathway which transforms the present situation into a sustainable energy supply, within a single generation. Exploitation of the large energy efficiency potential will drastically reduce primary energy demand. The major Renewable Energy Sources contributing to the electricity production in 2050 will be technologies that are already technically advanced. Solar Photo Voltaic will contribute 25%, Wind 20%, Hydro 11% and Biomass 6%. Large hydroelectric projects that are already established or are in an advanced construction phase will still contribute to Hydroelectric Power in 2050, but as funding of such projects will be discontinued in 2050, small, mini and micro Hydros will contribute to two thirds of the Hydroelectric power. The potential for biomass will be limited to agricultural wastes and the use of wasteland.

Annexure: 12

Time for Plan B: Cutting Carbon Emissions 80% by 2020

Earth Policy Institute, Washington had looked at ways and means of reducing the CO_2 emissions to contain Global Warming. After a detailed examination of the energy resources and the existing technologies available throughout the world, this study has projected the following composition of various electrical energy sources as compared from 2006 to 2020: coal power from 39.9% to negligible; oil power from 6.2% to negligible; wind power from negligible to 38.8%; hydro power from 15.8% to 21.5%; nuclear power from 15% to 11.5%; solar power from negligible to 11.4%; bio-mass from negligible to 5.8%; natural gas from 19.7% to 4.6%; and geo-thermal from negligible to 6.5%. This report highlights the fact that as per the study by International Energy Agency the demand for electricity by 2020 can be reduced below the level of 2006 by ramping up energy efficiency. A global switch to high efficiency lighting would reduce the electricity demand by 12%. Ban the bulb campaign by 9 countries before 2017 has been highlighted. Much emphasis has been given for ramping up power generation capacity through wind, solar, bio-mass and geo-thermal because of low carbon footprint of these technologies. It is very important to note that Earth Policy Institute has come to the conclusion that keeping in view the huge costs involved in disposing nuclear waste, decommissioning the worn out plants, insuring reactors against catastrophic failures building nuclear plants in a competitive electricity market is not simply economical. Plan B energy economy of 2020 will see 90% drop in fossil fuel-generated electricity and five fold increase in renewably generated electricity. This report recognises the need for

massive and rapid mobilisation of resources to achieve the goal, but considers it necessary and feasible to view it as a war time emergency.
