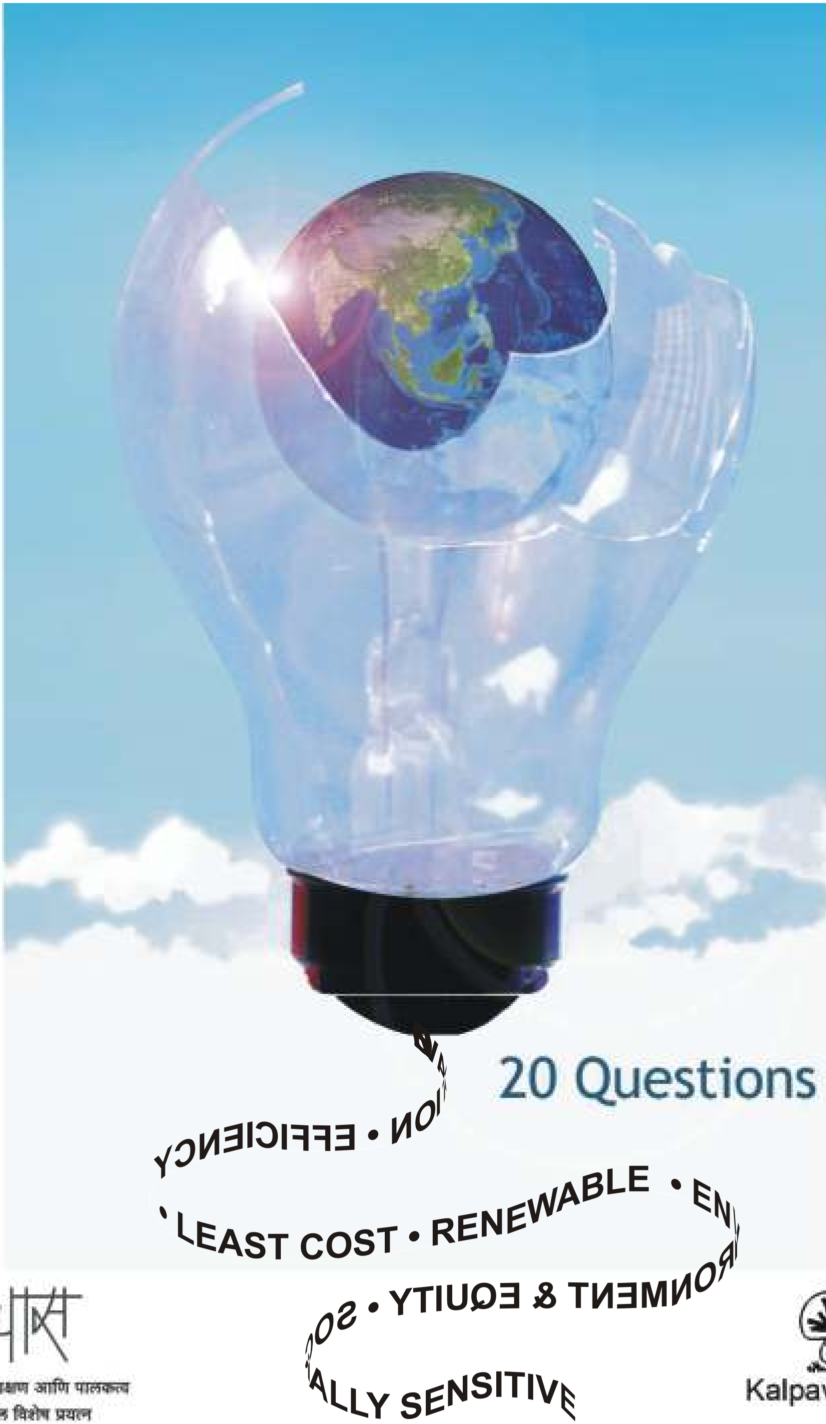
ALTERNATIVE POWER PLANNING



20 Questions

प्रयास

आरोग्य, ऊर्जा, शिक्षण आणि पालकत्व
या विषयांतील विशेष प्रयत्न

Kalpavriksh

Alternative Power Planning

20

Questions

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About Prayas (Energy Group)

Prayas is a registered charitable trust based in Pune. The activities of Prayas cover four substantive areas: Health, Energy, Learning & Parenthood and Resources & Livelihoods. The Energy Group of Prayas is mainly engaged in policy analysis in the electricity sector and capability building of civil society institutions.

The past work of Prayas Energy Group includes: analysis of the power purchase agreement between Dabhol Power Company and the Maharashtra State Electricity Board; analysis of the Sardar Sarovar Project; development of a least-cost, integrated resource plan (IRP) for the state of Maharashtra; analysis of agricultural power consumption and subsidy; critique of the activities of multilateral development banks in the energy sector in India and organisation of numerous capability building workshops.

Since the last few years, the Energy Group has focused mainly on issues relating to power sector reforms and regulation. Its work in these areas includes: study of the regulatory aspects of the Orissa model of power sector reforms; several policy and regulatory interventions at the Central and State levels; and survey based report on the Electricity Regulatory Commissions. In the current phase, the Energy Group is concentrating on issues thrown up by the passage of the Electricity Act 2003.

All major publications, presentations and reports of the Energy Group are available on the Prayas website. The activities of Prayas are supported through project-based grants from charitable foundations.

About Kalpavriksh Environment Action Group

Kalpavriksh (KV) is a 28-year-old NGO that works on environmental awareness, campaigns, litigation, research, and other areas. Kalpavriksh believes that a country can develop meaningfully only when ecological sustainability and social equity are guaranteed, and when a sense of respect for nature and fellow humans is achieved. To this end, its activities are directed to ensuring conservation of biological diversity, livelihood security, empowerment of local communities (especially through community-based conservation and management of natural resources), challenging the current destructive path of 'development', and reviving a sense of oneness with nature.

Over the years, KV's work has included research and advocacy on the environmental and social impacts of development projects and activities (for example dams and mining), and the environment decision-making processes for these. KV has supported people's movements, NGOs, activists and communities on these issues. Some reports/publications by KV members are:

· The Environmental Impacts of the Sardar Sarovar Project, Ashish Kothari and Rahul Ram
·Undermining India: Impacts of Mining on Ecologically Sensitive Areas, Neeraj Vagholikar and Kaustubh Moghe with Ritwick Dutta
·Large Dams for Hydropower in Northeast India: A Dossier, Manju Menon with Kanchi Kohli
·Eleven years of the Environment Impact Assessment Notification, 1994: How effective has it been?, Kanchi Kohli and Manju Menon
·Ecologist Asia: Special issue on Large Dams in Northeast India, Guest edited by Kanchi Kohli, Manju Menon and Neeraj Vagholikar

For information on other publications, please visit the Kalpavriksh website.

Introduction

The power sector in India is faced with many challenges - social, environmental and economic. Planners say that many new power generation projects are required to overcome the serious power shortage (leading to heavy load-shedding) that we are facing today. However, large thermal and hydro projects have already displaced lakhs of people, leading to serious social conflicts. Increased exploitation of fossil fuels and the ecological impact of loss of large tracts of forest cover due to power projects have led to growing worries about environmental and subsequent health problems. Technology like nuclear power is also accompanied by significant environmental, health and other risks. Also, the economic costs of installing these large plants and heavy reliance on imported fuel pose serious energy security concerns for India in the future. Can the country avoid economic shocks when the flow of fuels is disturbed or prices become unaffordable even in a growing economy? This is a question we need to ask repeatedly.

All in all, to address these concerns and ensure a sustainable way forward for the country, we need to understand the source of these problems, explore solutions for the same, and construct a model that would enable an equitable path for development. The following questions and answer format – let's call it a dialogue – is an attempt at understanding the issues involved in planning for the power sector. It provides a basic view of the components within the power sector and proceeds to outline a possible alternative to the current model of planning in the country.

The dialogue starts with a brief introduction to electricity and the power sector scenario in India. It then goes on to list the problems associated with the sector and the source of these problems. Finally, it proposes a possible solution for moving towards a sustainable power sector.

This booklet is a capacity building endeavour of the Prayas Energy Group and Kalpavriksh Environment Action Group. The idea is to aid consumer organisations, individuals and social and environmental activists, to participate in issues regarding the power sector and the changes happening therein.

This booklet is written by Tejal Kanitkar, Girish Sant and Sreekumar Nhalur of the Prayas Energy Group in association with Neeraj Vagholikar of the Kalpavriksh Environmental Action Group.

We would like to thank Mr. Mahesh Vijapurkar, Dr. Sanjeevani Kulkarni and Ms. Tejaswini Apte for their invaluable inputs.

1: How is electricity generated and how does it reach us?

Electricity is generated using different naturally available sources of energy like coal, oil, hydro, nuclear, gas, wind, solar, biomass etc. Various mechanisms are employed to convert the naturally available energy into electricity. For example, gas is burnt and the heat generated in this process is used to rotate a turbine. Thus, mechanical energy is obtained from the heat generated by burning of gas. The turbine, in turn, is connected to a generator which converts this mechanical energy to electrical energy. Similarly, dams are built on rivers and reservoirs are created. Water from these reservoirs is then used to rotate turbines to generate electric energy. Power plants which use gas, coal or any petroleum-based product like naphtha are all called thermal power plants. Those using water from dams are called hydroelectric power plants.

Electricity generated at power plants, is then transmitted via high voltage transmission lines to substations located close to the consumers. At these substations, the voltage is reduced and electricity is distributed to consumers via a network of low voltage distribution lines. *Figure 1* illustrates this entire process.

The unit used to measure electricity is Watt (W).

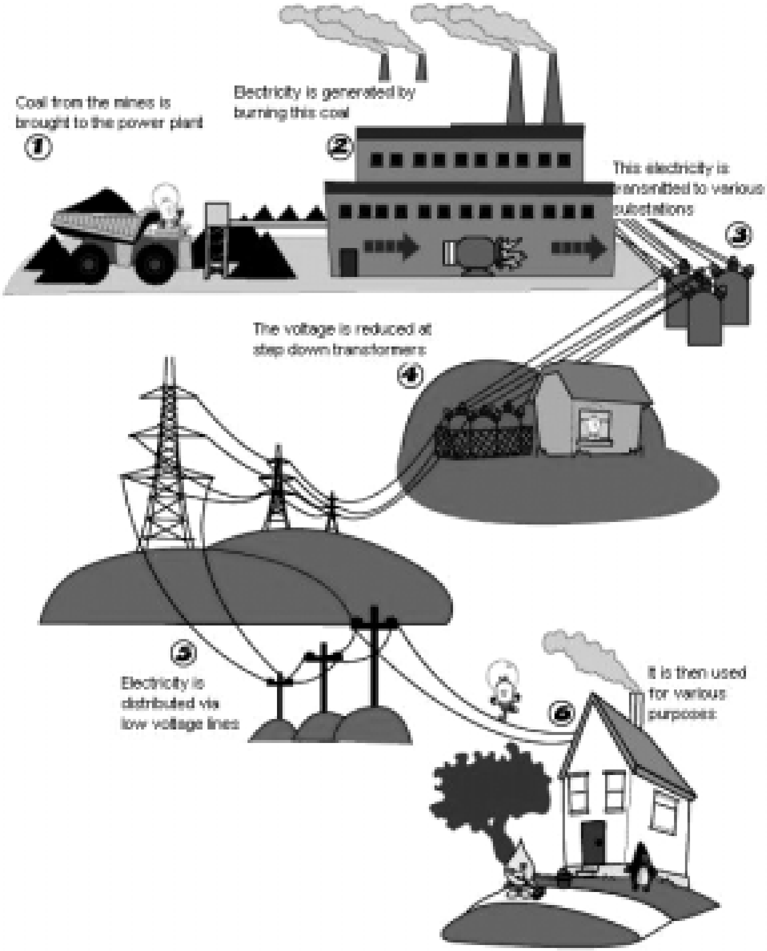
1000 Watts = 1 kilo-Watt (kW),
10,00,000 Watts = 1 Mega-Watt (MW),
100,00,00,000 Watts = 1 Giga-Watt (GW)
and so on.

We would be using these units throughout this booklet to indicate the demand for electricity or the amount of electricity that is generated or is required to be generated.

The other unit used is for electric energy: kilo-Watt-hours. It is a measure of the energy used when 1 kW power is consumed for 1 hour. This is also simply called Units.
Million Units (MU) = 1000,000 kWh.

If a 100 MW station generates power for 1 year, it generates 876 MU of energy, because one year has 8760 hours.

Coal required for 1000 MW of power = 11,000 tonnes/day
Gas required for 1000 MW of power = 3 Million Standard Cubic Meters/day (MMSCD)



Coal from the mines is brought to the power plant
1
Electricity is generated by burning this coal
2
This electricity is transmitted to various substations
3
The voltage is reduced at step down transformers
4
5
Electricity is distributed via low voltage lines
6
It is then used for various purposes

Fig. 1

2 : What sources of energy are used to generate electricity in India?

Sources used for electricity generation can be broadly classified into two categories: those that use conventional sources and those that use non-conventional sources (also called new and renewable energy sources). Conventional sources are those that have traditionally been used to generate electricity. These include fossil fuels like oil, gas and coal formed by many millennia of biological processes under the earth's surface, as well as nuclear sources. Large hydro projects have also been in use for many years as a method of power generation. Non-conventional sources like wind, solar, biomass, small hydro projects etc. have not been used extensively for power generation so far. The following pie-chart (Fig. 2) shows the share of each of the sources in the total installed electricity generation capacity in India, as of May 2006.

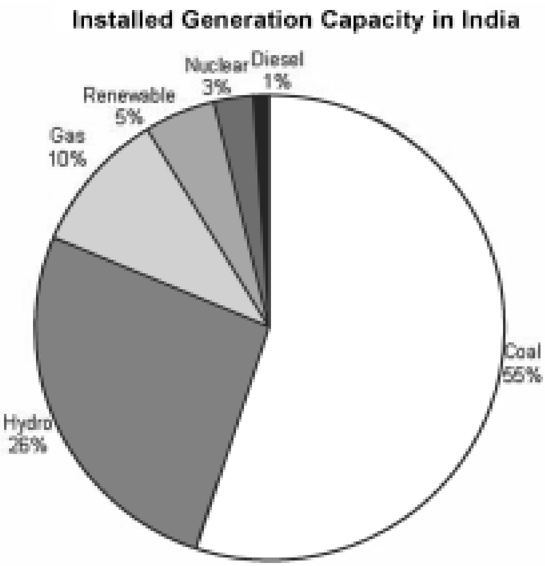


Fig. 2

It can be seen that most of the electricity in India – that is, 81 per cent - is obtained from coal and hydro-based generation. Of the hydro-based generation, 94% is from large hydro projects (projects generating more than 25 MW).

3: And what are our electricity needs, say in a year?

The demand for electricity varies from time to time; it varies according to the season - for example, in the summer months, due to high cooling load, the demand increases. Demand even varies according to the time of the day - for example, in the evenings when many lights are switched on together, the demand increases. The maximum demand experienced by the utilities (electric companies) in a period is known as peak demand. The period of lower average demand, experienced at other times when usage drops, is known as the base demand.

It must be remembered that the reported peak demand occurs for a very few days in the year – typically during the summer. During these summer months, the electricity shortage in the country is very acute and the utilities have reverted to heavy load shedding. However, the demand-supply gap reduces in the other months when the demand for electricity is low – in the monsoon months for example.

The peak demand in India in the year 2005-06 was approximately 1,06,000 MW. The installed capacity of all projects, thermal and hydro, was 1,23,541 MW.

4: Peak demand is 1,06,000 MW and installed capacity is 1,23,541 MW. This means that the demand is less than the electricity generated. So, how come there is a shortage?

Firstly, it must be remembered that the demand mentioned above is for the current year. Our demand for electricity increases each year. In a business-as-usual scenario, it can be assumed that the rate at which demand for electricity grows is nearly at the same rate at which our economy grows.

Secondly, these numbers indicate only the gross installed capacity. The actual operating conditions of the power plants may be different. For example, a dam for a hydro project might be built to generate 100 MW, but may generate a lot less due to variable climatic conditions, like low rainfalls etc. Similarly, lack of fuel supply to the plant can also be a reason for lower generation. Also, plants require some amount of down time in a year for repair and maintenance work. In addition to these factors, the plants themselves consume some electricity during operation which reduces the total amount generated. Thus it can be seen that "total installed capacity" does not translate into the total electricity that is supplied.

Also, from the point where the electricity is generated till it reaches our homes or offices, i.e. while it is being transmitted and distributed, there are several instances of losses incurred, usually referred to as Transmission and Distribution losses (T&D losses). These losses have two components - the technical and the non-technical losses. In India, the aggregate losses are substantial at 30 to 40%. 19 - 25% of this loss is non-techincal and mainly consists of theft. Technical losses occur due to various reasons, some of which are unavoidable; for example the losses in high voltage transmission lines are lesser as compared to the losses in low voltage distribution lines. Moreover, in a system like ours where we have centralised power stations and distribution lines spread far and wide, the losses tend to be a lot higher than in a system that has smaller distribution networks. Although not all of these losses can be avoided, the technical loss component in India can definitely be improved – or lowered - from its current estimated figure of 12 -18%. Countries like China and the USA have T&D losses of only 7% and 6% respectively.

Thus, with all these factors put together, the actual electricity available for use is far less than electricity generated, resulting in shortages. It is evident that better management of all three – generation, transmission and distribution – systems will lead to a better supply-demand situation. Efforts to do this have begun in the last few years, but are fragmented and have been successful only in pockets.

5: So why is there a problem in building large hydro and thermal plants to overcome these shortages?

There are growing worries about global warming and pollution, increasingly visible adverse effects on the forests, rivers and farmlands, and increasing political conflicts due to displacement of a large number of people for these plants. Thus, it is imperative that we move towards more environmentally friendly sources of electricity generation and adopt a model that is people oriented and works within an equitable energy development paradigm.

6: Exactly how big and serious are these problems? Let us discuss one problem at a time.

(i) The social costs of implementing such large projects, both hydro and coal, are large. The area needed for such large projects covers hundreds of hectares and is acquired from the people living on this land. They include farmers, farm workers, the tribal peoples etc. This ultimately leads to land-based and other social conflicts. Take, for instance, the Sardar Sarovar Project on the river Narmada. At its proposed full height of 136.5 meters, it would displace 3,20,000 people and affect the livelihood of thousands of others, and in turn provide a generation capacity of 1,450 MW. That is equivalent to only 1% of our current demand. Another example is the Tehri Project, with a height of 260 meters; having affected about 10,000 urban and rural families, it provides 1,000 MW of power (less than 1% of current demand) and drinking water to the industrialised cities of Delhi, Uttarakhand and Uttar Pradesh. The new ultra mega power projects being proposed also require acquisition of more than 2,000 hectares of land for each project. This will naturally mean displacement of many more people leading to many social and political conflicts. Also, it is not just power plants that cause displacement. Related activities like coal mining also affect a large number of people. A Ministry of Coal report (Coal Vision 2025) estimates that approximately 8.5 lakh families will be affected by coal mining by 2025. In areas such as the Northeast (where almost 168 hydro plants of over 60,000 MW total capacity are being conceived of), even though direct displacement is low from a national perspective, large hydro projects are having serious socio-cultural impacts on vulnerable indigenous communities, including the loss of ecosystem-based livelihoods in areas upstream and downstream of the planned projects.

(ii) There are environmental costs associated with these large projects as well. Global warming resulting in climate change is one such environmental cost resulting from the

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Biodiversity- rich ecosystems on the Assam – Arunachal Pradesh border will be seriously impacted by the 2000 MW Lower Subansiri hydroelectric project.

Bittu Sahgal/Sanctuary

excessive exploitation of fossil fuels like coal, oil and gas. The phenomenon, simply explained, means that the temperature on earth is increasing to dangerously high levels due to an increasing amount of carbon being trapped in its atmosphere. The main source of this excessive carbon in the atmosphere is the burning of fossil fuels in large quantities. Also, large scale deforestation is undertaken for building large projects. This further contributes to environmental degradation. A recently conducted study also cites that large dams in India are large contributors of methane emissions, one of the gases responsible for global warming. Hydro power projects are also accompanied by other serious ecological impacts on the region, which cannot be ignored. For example, large dam building activity in the Himalayas is accompanied by serious environmental risks due to the geologically fragile and seismically active terrain. It also has other impacts like submerging hotspots of biodiversity and adversely impacting riverine ecology.

Effects of power plants on the local environment are also plenty. For coal plants, ash content in the coal is an issue.

Indian coal especially has high ash content. When fly ash falls on land, it contaminates the soil. This is a serious problem often faced by land owners and land workers in areas surrounding coal plants. Also, coal mining releases approximately twenty toxic chemicals into the atmosphere.

Coal based thermal power projects cause serious pollution and are a major contributor to global warming.

Greenpeace

(iii) Large projects demand large economic costs. The capital costs for these plants are very high – material costs, infrastructure costs, labour costs etc. In case of thermal plants, the fuel costs are high; sometimes they are high due to short supply, or shortage of refining capacity, or heavy reliance on unstable imported supply. Even if fuel cost is nil for hydro projects, they are capital intensive, long gestation projects. This means that they cost a lot to build and it takes a long time to complete the construction.

These costs by themselves are significantly high, but still do not reflect many other costs associated with large power

Narmada Valley dam-affected persons protesting at Badwani, Madhya Pradesh

Ashish Kothari

projects. The costs for rehabilitation and resettlement of those affected by these projects are grossly under-calculated. Environmental degradation has a very high and long term cost associated with it, which is also never calculated; for example, the cost of short term and long term impact on the health of individuals and the society due to excessive carbon pumping into the atmosphere, the cost paid to strengthen energy security which is compromised in the first place by heavy reliance on imported fuel. The cost of loss of ecological services from forests and other ecosystems is also grossly under-calculated.

In case of nuclear plants many of these concerns get magnified. The generation of nuclear power creates radioactive waste. Touted many times as "clean fuel", the dangers of nuclear power like the safety hazards due to radiation, waste disposal problems and links to nuclear weapons can be much more serious than generally accepted.

7: Do we have to build these large plants? If they are so expensive, and also threaten social harmony why don't we consider alternatives like conservation or using renewable sources?

This question brings us to the critical shortcoming of the conventional method of energy planning. The conventional method of planning concentrates solely on building large plants while giving a subordinate treatment to energy efficiency, conservation and decentralized renewable sources. Hence, building large plants is an assumption as well as conclusion of the conventional method of planning.

8: How so?

The entire process is a vicious circle. Let us start with the demand forecasts that planners make. Usually these are an over-estimate, without any consideration for management or curtailment of demand, i.e. conservation of energy, elimination of energy wastage and improvement of efficiency. To be able to supply this highly inflated demand, the planners who are already biased towards centralized plants, plan for mega power projects. Also, there is a direct correlation between energy and economic growth. We often hear our politicians talk about an increase in energy consumption to be able to sustain the current growth rate of 8 % and more. Thus to encourage consumption and subsequently maintain economic growth, planners endorse new power projects. For constructing these new mega power projects, planners rely on huge capital investment from the government and private investors. Whereas, the more economical but smaller options of de-centralised projects, efficiency improvement, and demand side management

(DSM) are neglected or de-prioritized resulting in high cost of power. This calls for subsidy provision by the government as most consumers who are either non-commercial or non-industrial users in the country would be unable to pay such high costs for power. This provision of subsidy to make low priced power possible for such users is a disincentive for investments in efficiency improvement and in turn leads to inefficient use of power. This, in turn, results in a further higher demand for power. The circle is thus complete with the demand forecast being much higher than it ought to be, leading to an unsustainable model of power development.

This conventional method of planning is being increasingly questioned and some perspectives are changing, although very slowly.

9: But if we need to increase consumption in order to achieve economic growth or development, then it seems logical to make provisions for the same, doesn't it?

It is true that electricity is necessary – both for basic uses (like lighting) and for livelihood generating purposes. However, if every spurt in "economic growth", translates into the displacement of thousands of people and irreversible damage to the environment, then our development paradigm also needs serious inspection. When we talk of "electricity for development" we first need to answer the question: "What is development?" If our objective is to satisfy the basic needs of all (starting with the needs of the poorest) and strengthen self reliance (livelihood and its security), we need to change our current "more consumption for more economic growth" perspective. Also, there are very real limits to such growth. With high levels of uncertainty about the availability of resources (coal, oil, gas etc.), the need to rethink the development paradigm becomes all the more urgent. What do we do then?

To achieve equitable and sustainable development, a different outlook towards energy and its consumption is necessary. Energy consumption by itself does not mean much. It is the energy services that are important. Thus the method of planning adopted should focus on an increase in the services provided by electricity, while concentrating on how to deliver these most efficiently and at the least cost.

A serious focus on renewable sources of energy would be a step toward trying to address concerns of environmental degradation and sustainability. But even before this, there are many low cost efforts that can be taken up to improve the current systems. To achieve this, a change in the current fragmented planning methodology is necessary. Integrated Resource Planning (IRP) includes both, an alternative perspective as well as a more cohesive planning process.

10: What is Integrated Resource planning?

A definition of IRP encompassing all its aspects is given below.

IRP is an improved energy planning approach to meet the requirement for increasing energy services. It considers a mix of supply-side and demand side solutions while giving equal importance to both. It includes a combination of clean centralised energies, decentralised renewable energies and efficiency improvements, which will together provide energy services at least costs.

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11: Can you explain IRP a little more in detail?

At the risk of sounding repetitive, first and foremost, it is necessary to understand that individuals and societies do not want energy *per se*, but want the services that this energy provides. For example, we want and use lights, heaters and refrigerators. Therefore when we talk of development, what we really want is an improvement and growth in the energy services that are provided. An "increase in energy consumption" won't mean anything to us if it does not improve and increase the energy services. IRP considers this as a basic parameter for planning and this is its fundamental difference from conventional planning methodologies.

Now, there are two ways of increasing the energy services: one is improving the efficiency of energy devices and technologies and the other is increasing the energy supply. An increase in the energy supply can either be achieved by centralized generation using conventional (and sometimes non-conventional) sources of energy – coal, gas etc. or de-centralized generation from non-conventional sources of energy – solar, wind, biomass etc.

IRP considers both supply-side measures (like building new plants) and demand-side measures (like improving energy efficiency) on a level-playing field.

This, integrated approach to power planning inherently reduces the economic, social and environmental costs associated with conventional planning.

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12: So IRP advocates a mix of these two? Can the contribution by decentralised renewable sources be substantial?

Yes, IRP advocates an optimal mix that considers a least-cost approach to energy development. As far as decentralized generation is concerned, experience in other countries indicates that the contribution can be substantial. In Denmark for example, 20% of all power generation is from wind turbines and most of these are locally owned and operated. Other than the fact that de-centralised renewable technologies are generally more environmentally friendly than the conventional sources, a very important advantage that they provide is the placement of generation close to the point of consumption. This eliminates the need for long transmission and distribution lines, thus, in turn, greatly reducing the T&D losses. Apart from power generation, renewable sources of energy can also be effectively used to replace certain electricity intensive appliances. For example, in certain areas solar water heating can easily replace the use of electric heaters.

13: And how does the second aspect of IRP, i.e. efficiency improvement, work?

Whereas conventional planning focuses solely on supply-side options to increase energy production and consumption, IRP includes demand-side options like improvement of energy efficiency and conservation of energy. This approach is called end-use orientation. It concentrates on the end-uses of energy and the services to be derived from energy, rather than the quantity of energy used. What is important to remember is that the attainment of a certain amount of

heating, lighting or motive power, would not necessarily lead to an increased energy usage. Technological improvements in various appliances can lower the need for energy (i.e. improve energy efficiency) while retaining the same level of energy services.

For instance, there are two solutions to meet the peak demand every evening, when commercial and residential lights are turned on. Planners could build a new power plant just to meet this peak-time demand (hydro or gas based peaking power plants which require shorter start up times) – this is what conventional planners would do. Or they could replace all incandescent bulbs by say Compact Fluorescent Lamps (CFLs) which provide the same amount of light but consume less energy (i.e. they are more energy efficient). An ordinary bulb consumes five times more power as compared to a CFL. However, CFLs today are relatively more expensive; the common designs of CFLs have some technical problems, issues related to mercury pollution and quality control. However, with appropriate measures like credit management to make CFLs affordable, quality control, safe disposal options/ recycling and technological developments in the short and long term, along with focused policy initiatives, these problems could be ironed out. With time, other lighting technologies like LED (Light Emitting Diodes) are also becoming more efficient than CFLs.

A rational planning process should compare the costs of the above two solutions - power plant for peak periods v/s installing CFLs. The second solution is less expensive, less polluting and more reliable to meet the power demand. It also serves as an immediate response mechanism to increases in demand. Moreover, it avoids construction of peaking power plants and their associated environmental and social costs. There are many other existing efficient technologies not only in lighting, but also in heating, washing or ventilation.

14: You mean to say efficiency improvements can substitute new capacity addition completely?

Not at all! New capacity addition will be needed as our economy grows, more industries come up, more people get access to electricity etc. But the number of new projects that are needed are grossly overestimated by conventional planners because they neglect the easier, cheaper and faster options. IRP views the energy needs and problems holistically and thus comes up with better and optimal solutions. For example, the IRP study done for Karnataka reported that the amount of new generation required in the state was about 50% less than that reported in the official conventional plan.

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15: But some time or the other, the improvements achieved by efficiency will get exhausted, right?

What you say will happen only if we assume that there will be no new research and development of better and more efficient technologies in future. Besides, irrespective of whether or not it will be the answer to all our energy problems, it is necessary to invest in and adopt energy efficiency on a priority basis. Unless we do this, we will not give the due encouragement and required market for these technologies and thereby in fact suppress the possibility of development of newer, more efficient technologies.

16: Quantitatively speaking, how much impact can efficiency improvement have? Can you give me a real world example?

Certainly! Take the example of the state of California in the USA.

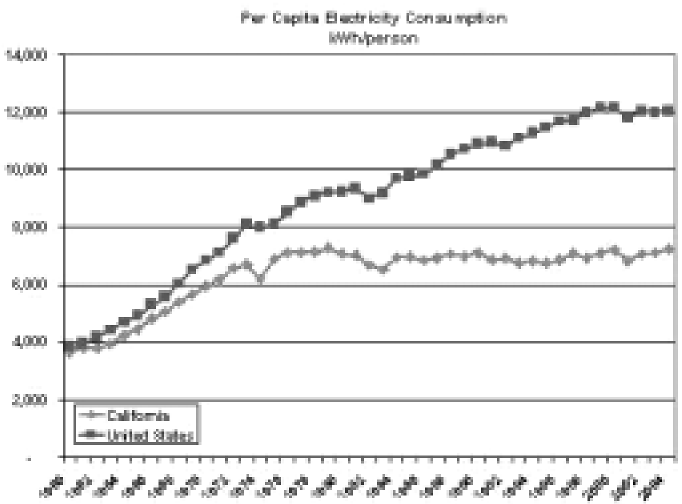

Fig. 3

The graph in Fig. 3 shows the trends for per capita electricity consumption (kWh/person) in the state of California as well as in the United States for the last forty years. The above graph tells us that the energy consumption in California has either remained stable or increased at a much slower rate than in the rest of the United States. The two trends seen on the graph start diverging significantly after 1970 when California introduced energy efficiency programs and imposed efficiency standards on manufacturers of certain appliances. Efficiency standards are mandatory levels of efficiency that certain appliances, say refrigerators or heaters, should meet before they can be sold in the market. This focus on energy efficiency resulted in net annual savings of $1,000 for each consumer in California.

Although it falls into a different category (not energy efficiency), it is necessary to cite an Indian example here. The Akshay Prakash Yojana implemented in Maharashtra attempted to regulate power use through consumer-utility partnerships. The scheme included initiatives toward taking collective responsibility for tackling load shedding problems in the villages. Villagers were asked to regulate electricity use during peak hours, using it only for essential services during these times; thus electricity used for agricultural pumps, flour mills, lights required in schools etc. was scheduled for use only during the necessary hours. Theft was also checked and people were asked to give up appliances consuming extremely high amounts of electricity, e.g. hot plates, heaters etc. In return they were given 22 hours of assured electric supply in a day. This scheme had been implemented in 4,611 villages and had reduced the peak demand by 960 MW. The interesting aspect of this program was that the people got involved in solving a problem which, to start with, was not entirely of their making. They made 960 MW of energy available to others at no cost. A new 960 MW gas based plant would have approximately cost Rs.3000 crore.

17: These are really great examples! Who are the planners who take these decisions? Who should do IRP?

IRP can be done at the local, regional to national levels. The main actors in an IRP process are energy utilities (power generation, transmission and distribution companies), government agencies (power ministry and others), regulators (state or central electricity regulatory commissions recently set up in India to regulate electricity tariffs etc.), consumers – industrial, agricultural, domestic etc. and civil society organizations – environmental organizations, consumer interest groups etc.

For example in California, the energy efficiency programs were introduced and implemented by government agencies, regulatory bodies and utilities together. In 2003 the state saved 15% of the annual energy use in the state due to the application of appliance standards (mandatory standards for certain electrical appliances), building standards (mandatory standards for buildings to meet certain efficiency targets) and utility efficiency programs. In India, the Ministry of Power has established a new body - the Bureau of Energy Efficiency (BEE). BEE is expected to devise ways to improve energy efficiency in various sectors throughout the country – e.g. construction, industry etc. However, these are examples of IRP specific only to the power sector. IRP can be adopted and applied across various sectors.

18: Across various sectors? How so?

IRP can be adopted in water management and infrastructure management along with the power sector. This would not only enable efficient resource management in general but also lead to energy savings. For example, at water pumping stations, large amount of water is pumped to different parts of the city. The greater the quantity of water to be supplied, the higher is the pumping power required. In other words, larger pumps are required. Thus every drop of water saved helps in reducing the pumping power required at the source. It also reduces the need for developing additional water supply sources (such as dams). Hence, a rational planning process should compare the cost of water conservation or stopping the leakages with the cost of building new dams.

Similar concepts can be used in infrastructure planning. For example, encouragement of the use of public as opposed to private transport can go a long way in reducing the need for additional roads and also saving energy.

There are steps that can be taken in sectors other than power that can help improve the situation in the power sector. For example, mandating the use of fly ash based cement in the construction industry can help in reducing the energy used in cement factories and also reduce the impact of waste fly ash from power plants on the environment. Similarly, enhanced ground water recharging can reduce the amount of power required to pump this water out of the ground. These can also form part of IRP.

19: So why is IRP not being adopted by our planners?

Well, one of the main reasons is the well established norm of opting for centralized generating systems. IRP is a relatively new concept and would mean a radical change for our energy planners which they are reluctant to adopt. There is also a belief amongst our energy planners that energy conservation is not for developing countries because consumption levels are already very low.

Generally large plants have bigger political pay-offs because they seem impressive. So we see that the plans that are made for the future almost always consider the business-as-usual scenarios and plan for capacity addition without any focus on reducing the inherent losses and inadequacies. Another reason for this is a fragmented decision making process. Decisions for efficiency improvement, whenever taken, are independent of decisions to invest in more supply addition. Thus energy efficiency is inevitably ignored while planning for the future.

Another reason why IRP is not being adopted widely is that the costs of conventional energy capacity addition are heavily under-calculated. As we discussed before, many hidden costs are underestimated, thus distorting the actual damage done by visionless planning. These are some of the factors that contribute to continued reliance on conventional planning while relegating IRP to the background.

20: What can I do to improve the situation?

One can find an answer to this question at multiple levels.

The active measure that we as individuals can take is to pro-actively conserve energy. Opting for energy efficient appliances, and conserving energy by eliminating wastage of energy in our houses and work places would be the first step toward sending strong signals to manufacturers as well as planners.

However, to change the situation, it is most important to inspect and change one's own perspective on energy first. We have to recognize that development is not equal to economic growth and increasing energy consumption. We need to increase energy services with a primary focus on livelihoods and other basic services for the poor. We also need to recognize that the cost of energy produced is paid not just in terms of money but also in terms of social impacts and environmental degradation. Once we understand this, the next step is to convince our policy makers, planners, regulators and service providers. Creating public support for changing social perspectives towards development-growth-energy linkages and adopting IRP will be a huge step forward in promoting it. Media advocacy, advocacy through strong public representation during regulatory hearings, and active support to planners, utilities and regulators who are pushing for IRP are some steps that can be taken in this direction. Writing to the Bureau of Energy Efficiency, the State Electricity Regulatory Commissions, people's representatives, and utility heads to focus on IRP are some active steps that can be taken.

An aware and active society would go a long way in persuading planners that their focus needs to shift to a least-cost and equitable plan for energy development.

Coal mining has destroyed some critical ecosystems and agricultural lands, as well as displaced lakhs of people. The mine below is from the North Karanpura Valley in Jharkhand.

CASS

Glossary of terms

- *Base load* : The minimum load demanded over time on a power company's generation system.
- *Demand Side* : Relating to the end use of electricity (consumption) rather than the production of electricity.
- *Demand Side Management* : Any utility's or government's activity designed to influence energy consumption. It includes Load Management.
- *Energy Conservation* : An overall reduction in energy use.
- *Energy Efficiency* : Improving the efficiency with which the energy is used while maintaining or improving the level of energy service.
- *Greenhouse gases* : Gaseous emissions that contribute to global warming. They include:
  CO_2 (carbon dioxide) from burning fossil and other fuels
  CH_4 (methane) from agriculture, landfill sites, and coke production
  CFC (chlorofluorocarbon), HCFC (hydro chlorofluorocarbon), and HFC (hydro fluorocarbon), used in refrigerants and aerosols
  N_2O (nitrous oxide) from nylon production, nitric acid production, fossil fuel burning, and agriculture
  SF_6 (sulphur hexafluoride) from the chemical industry
- *Integrated Resource Planning (IRP)* : A set of regulatory policies and utility planning practises to develop demand-side and supply-side resources that are in the best social, environmental and economic interest of society.
- *Load Management* : Any action taken by the customer and/or the energy supplier to reduce total system peak load and/or improve utilization of valuable resources.
- *Motive Power* : Motive power is defined as a natural agent, as water, steam, wind, electricity, etc., used to impart motion to machinery; a motor; a mover.
- *Non-renewable resources* : Exhaustible resources that cannot be regenerated or renewed by making direct or indirect use of energy from the sun. They include fossil fuels.

- *Peak Load* : The maximum demand for electric power. More generally, it is the maximum load consumed over a stated period of time.
- *Renewable resources* : Sources that originate from the storage of solar energy in living organisms or in the earth's weather system (wind, rain etc.). If sufficient water, nutrients, and sunshine are available, these resources are renewed in continuous cycles.
- *Supply Side Management* : Measures taken by utilities on power plants – right from adding new plants to managing existing plants.
- *Transmission and Distribution Losses* : The losses associated with providing eectricity from generators to end-users.
- *Watt (W), Kilowatt (kW)* : The unit of 'useful' electric power. One kW equals 1000 watts. At many electricity companies, customer demand in the system at any time is measured in kilowatts.

Additional Resources

There are many renowned persons who have done remarkable work on IRP. One such person is the late Amulya Kumar N. Reddy. He has a large list of publications on energy and planning, some of which can be found at
http://www.amulya-reddy.org.in/
Some other resource links are also listed below:

- *Sant, G & Dixit, S. 1996.* Least Cost Power Planning: A Case Study of Maharashtra State. *Prayas. Pune.*
- Tellus Institute. 2000. *Best Practice Guide: Integrated Resource Planning for Electricity.* Boston.
- BC Hydro. 1995. *Integrated Electricity Plan.* Vancouver.
- Swisher, JN, Jannuzzi, G and Redlinger, RY.1997. Integrated Resource Planning: Improving Energy Efficiency and Protecting the Environment. UNEP Collaborating Centre on Energy and Environment. Denmark.
- Centre for Energy & Environmental Policy and Kalpavriksh. In Progress. *Handbook for IRP Advocacy.* Delaware/Pune.

The incandescent bulb was the first major invention that promoted widespread electricity use. Even after 128 years of its invention, this inefficient source of lighting remains a symbol of the power sector and the services it provides. Today the sector faces a number of challenges. While close to half of India does not have access to even basic electricity services, there is a comparatively larger quantity of electricity wasted due to neglect and inefficiency by the other half. Even as we focus our efforts on finding financial and fuel resources to provide more electricity, primarily for the fast growing economy, the serious social and environmental impacts of the power sector are a major cause for concern. Meeting these challenges would require us to break the shackles of the conventional power planning paradigm.

This booklet is a capacity building endeavor of Prayas Energy Group and Kalpavriksh Environmental Action Group. The idea is to aid consumer organisations, individuals and activists, in understanding an alternative approach to power planning.

www.prayaspune.org/peg

www.kalpavriksh.org