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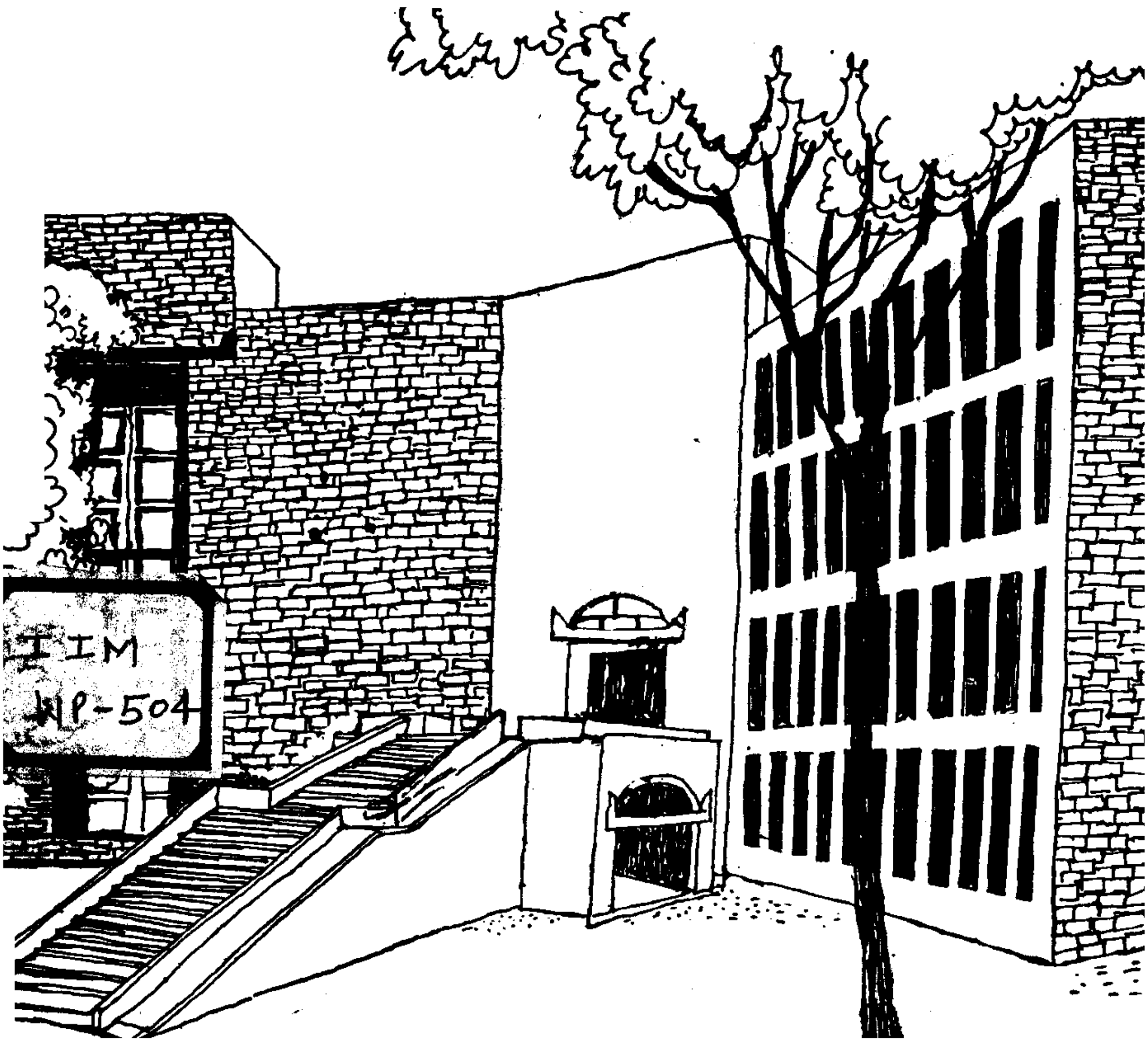

ENERGY PLANNING IN INDIA: A REVIEW

By

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Energy Planning in India : A Review

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Abstract

Energy occupies a central place in our lives. All our activities have energy content and hence energy is a basic need. The history of economic development can be seen as the history of structural change in energy consumption. The energy transition from coal to oil after 1945, the emphasis on conservation and fuel efficiency since 1973, the present firewood crisis - all these mark important shifts in theeconomy. Planning for energy development and use was relatively less important till about fifteen years ago and it usually meant increasing the supply of energy from various sources. Recently, however, this situation has changed. Energy now is scarce, expensive and unreliable. Energy planning as a process by which decisions are made on the provision of sustainable energy systems including the development of energy sources and utilisation of energy, has become very important around the world and in India. This paper reviews the nature of energy planning in India, the methodologies used in energy planning, its structural features and institutional framework. It proposes some guidelines for making energy planning effective, given our socio-economic and developmental context.

Energy Planning in India: A Review

R.S. Ganapathy*

1. Introduction

Energy occupies a central place in our lives. All our activities have energy content and hence energy is a basic need. The history of economic development can be seen as the history of structural change in energy consumption. The energy transition from coal to oil after 1945, the emphasis on conservation and fuel efficiency since 1973, the present firewood crisis - all these mark important shifts in the economy. Planning for energy development and use was relatively less important till about fifteen years ago and it usually meant increasing the supply of energy from various sources. Recently, however, this situation has changed. Energy now is scarce, expensive and unreliable. Energy planning as a process by which decisions are made on the provision of sustainable energy systems including the development of energy sources and utilisation of energy, has become very important around the world and in India. This paper reviews the nature of energy planning in India, the methodologies used in energy planning, its structural features and institutional framework. It proposes some guidelines for making energy planning effective, given our socio-economic and developmental context.

2. The Nature of Energy Planning

Energy planning means different things to different people. Pricing electricity, growing fuelwood in the public lands, design of energy conservation in a factory, investment

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in oil exploration, opening a post graduate department in power engineering and, sponsoring a R & D project in solar photovoltaics are all examples of energy planning decisions. Energy planning can be classified functionally (finance, marketing) subsectorally (coal, oil, power) globally (input-output or simulation models of the energy-economy linkages) or in terms of land use (housing, transport, cooking, industrial operations etc.). It can be done nationally and at a village or household level. I would characterise all energy planning as consisting of some intervention usually by a public agency, to achieve some objectives regarding energy. Energy planning is linked systematically to resource endowment, ecosystem characteristics, structure of economic activities, international trade linkages, sectoral needs, development goals, technology and even lifestyle and culture. There is a growing recognition that energy planning cannot be done in isolation but only in relation to several other factors (Menon, 1983).

For individual projects (construction of a power station, development of a coal mine) planning is a component of capital choice and operations management as evidenced by investment appraisal using cost-benefit analysis or application of system analysis to electric power networks. At an aggregate level, Indian planning consists of macroeconomic analysis to guide decisions regarding fiscal, monetary and trade policies and resource allocation. In the hierarchy of planning activities, energy sector analysis lies somewhere between the two extremes, with active links to economy wide issues and to studies of project details.

Historically, only supply enhancing investment decisions (electrification, production from an oil well or coal mining etc.) were common in energy planning. Overall energy growth pattern or the mix of energy sources were hardly questioned. Since the seventies when the oil crisis became a reality, energy planning in a comprehensive manner for multiple dimensions of the energy sector (supply, demand, technology, conservation, sources etc.) began. Energy planning involves analysis of alternatives and choices in selection of fuels, technology for production and end use, scale, location and timing of investments, role of traditional fuels like agricultural and animal wastes, and determination of prices and subsidies. All these decisions are highly interdependent both within the energy sector and intersectorally. As energy demand is a derived demand from various end use sectors, energy planning and development planning are integrally linked. The concept of sectoral planning for energy implies that several other pieces of the planning system are in place and effective information flows exist to take care of interactions between macro and project/enterprise level issues.

Indian experience in such comprehensive energy planning is limited and recent. We do not have sufficient understanding of the complexity and richness of the energy sector. The history of the sector has been characterised largely by a set of supply oriented decisions, not quite linked to each other. Our institutional structure in government and the evolution of policy in energy also indicate the fragmentation that exists in the energy sector. Yet, India is making significant progress in energy planning in its multiple perspectives. We shall now review the use of the different methodologies in energy planning in India.

3. Energy Planning Methodologies

Methodology can be defined in two ways: (a) the epistemological assumptions on which the search for knowledge is based, and (b) the set of methods, techniques and approaches that are used in the acquisition and analysis of data for the solution of an energy problem. In this paper, the term methodology is used in both these meanings interchangeably. I shall argue that each methodology not only generates a distinctive set of conclusions but also implies a prior, often implicit, formulation of the problem. Thus, if the energy crisis is viewed as a supply, demand or a technological problem, the solutions respectively will differ, and so will be the associated methodologies. Problem formulation in the energy sector is dependent on a theory which organises data and facts (Ganapathy, 1981). To get a meaningful insight into the energy questions and get a comprehensive understanding of the energy reality, - creation of a energy "gestalt" - we need multiple methodological perspectives, which formulate the energy problem differently. We cannot ascribe ontological or epistemological primacy to any methodology or mode of inquiry. I shall proceed to review and critique some of the major methods used in energy planning which are global, sectoral and regiona/local/organizational ranging from macro to micro levels in a continuum.

Traditional energy models throughout the fifties and and sixties viewed energy demand as a function of Gross Domestic Product growth rate and energy supply planning as planning for a series of major investment projects in each supply source and imports. Later, refinements were made by introducing time, variations in production structure, disaggregation of demand in various end uses and technology. Energy use - GDP correlations were worked out and more energy consumption was uncritically assumed to imply development or a higher quality of life.

In such planning, non commercial energy and nonmonetary demand which constituted over 50 per cent of total energy use in Ind was left out. The focus on gross primary energy rather than useful energy ignored the critical importance of energy efficiency. The direct correlation with GDP implied that any economic activity associated with GDP increases is important whether or not that activity enhances or diminishes people's well being. Social and geographical distribution of energy use as well as the impact of prices on demand were usually ignóred too! On the supply side, independent analysis was done for each source, thus not considering fuel substitution. Till the 1973 oil crisis such energy planning was by and large prevalent. This model was found inadequate as the global and national energy scene changed and the need for simultaneous planning for energy demand and supply, in sufficient disaggregation (region, sector, social classes and groups) was slowly recognised. Given the qualitative and quantitative underconsumption of energy, high proportion of noncommercial sources, the gravity of the environmental problems associated with traditional energy use and the inefficiency of energy use, a different type of energy planning was needed. During this time, the need to match sources and uses of energy, to plan for energy based on the biogeography and people's needs, and finally the need for participation of people - the key stakeholders - in energy planning were recognised.

As we had mentioned earlier, energy planning in our country consisted largely of energy supply planning. It continues to be important, particularly so, after the oil crisis when finding indigenous sources of oil or substitutes became critical on account of balance of payments difficulties. In general, energy supply planning is concerned with the supply of needed energy by an optimum mix of energy sources through domestic production and imports. It is concerned with matching specific demand (for heat, light, mechanical or electrical energy in different forms) to supply in different forms. The energy supply can be increased in a step function whereas demand increases more gradually in a linear fashion. In any society, more so in ours, it is difficult to change energy use pattern in a short time as people's life styles (food habits, economic activities, transport etc.) change slowly and the capital stock of energy using equipment cannot be rendered useless overnight. Interfuel substitution in different sectors continues to be important on account of shortage of oil products. In some sectors, substitution is easier than in others. For example, the transport sector has the minimum substituion flexibility while cooking has the maximum flexibility. Over a long period of time, however, all fuels are substitutable since restructuring end uses will become possible.

During the sixties, a major planning exercise was the work of the Energy Survey Committee. This committee was appointed by the Government of India in 1963 and submitted its report in 1965. It consisted of a few officials and a large number of expatriate advisors and members. It projected demand for the next twenty years assuming a relationship between energy consumption and national income (alternative growth rates ranging from 5 to 7% per annum). The needs in Transport, Agriculture, Industry and Household sectors were projected separately and from the demand estimates supply strategies and investment were recommended. It was largely electricity oriented (Sankar, 1982).

The major methods used in energy supply planning are: (a) Resource Evaluation (b) Infrastructure planning (c) Manpower Planning (d) Project Appraisal and (e) Product mix planning.

Let us briefly review these methods. Resource Evaluation consists of assessment of potential energy resources that can be exploited economically. Such resources can be coal, oil, uranium animal wastes, solar radiation, wind etc. Some are non renewable and others are renewable. Data for such assessment is generated by geological surveys, mapping and exploration, and remote sensing through aerial surveys or satellites. From this data recoverable resources and rate of production can be established.

Infrastructure Planning usually consists of planning for roads, utilities, site evaluation, location analysis, and environmental impacts analysis that are needed before a energy supply project can be started. As many energy resources are located in remote, uninhabited areas, provisions of infrastructure before the development is necessary. Infrastructure planning often consists of land use and engineering analyses, evaluation of associated investments, choice among technologies and techno-economic studies.

Manpower Planning for the energy projects consists of estimation of manpower (technical, professional, managerial) requirements at various levels and phases of the project(s) and planning of recruitment, training and development, personnel practices etc. Such human resources planning is usually done at the project planning stage.

Product mix planning is relevant in the supply of petroleum products. Petroleum products are joint in nature. The present policy of government encourages the consumption of middle distillates (diesel and petrol) while penalising petrol. As production is joint, this may result in stock-piling of some products, necessitating exports. This might be true to a smaller extent in the case of coal and in the case of forestry. The competing claims of food and fuel (in the case of ethanol) in land use planning is well known. Even if petrol consumption is reduced by substitution, the country may have to import the same amount of crude to produce its diesel requirements. It can however export surplus products. More balanced reduction of oil products supply might save the country more money.

At the micro level, project appraisal, consisting generally of technical and economic feasibility analysis, is carried out. Financial viability is calculated by computing the rate of return. During the seventies, project appraisal became more sophisticated and included, discounted cash flow analysis, market research for demand assessment, site/location analysis, construction of production functions(for the "size" question) resource evaluation to estimate the economically recoverable reserves (coal, oil) and studies (electricity grid, transport network). Sensitivity analysis of the project viability, altering various parameters is also usually done. For the implementation of the project, use of techniques like PERT/CPM, for timing and phasing of activities, financial planning, manpower planning and other implementation analyses are carried out. For the ultimate approval of the project by the government, project appraisal is essential. The Planning Commission has a Project Appraisal Division and the Ministry of Finance, a Public Investment Board to approve investments. Project appraisal is quite common in India both in public and private sector energy activities. Work is going on to refine the Social Cost-Benefit Analysis by including environmental and distributive as well as higher order impacts (costs and benefits) into the calculus. A predetermined rate of return or cost of capital is employed in evaluating the projects. Sometimes Cost-Effectiveness Analysis is carried out to find out the minimum cost alternative to supply specific quality of energy. For example, rural electrification projects (either from central generation and transmission or local decentralised generation) are evaluated using cost-effectiveness analysis. (Makhijani and Pool, 1975; Ranganathan, 1977).

Planning for Energy Demand Management is increasingly becoming important in India since the early seventies when conservation of oil became very urgent. Energy demand can be reduced by reducing economic growth or by increasing prices significantly. However, what is usually meant by demand management is the elimination of waste through increasing the efficiency of energy use and fuel substitution. Sudden forms of reduction of energy demand can be very disruptive. In India, demand management has not been as effective as it is in other countries because of the following reasons:

(i) Benefits of increased energy efficiency are not obvious to industrial or household consumers.

(ii) The general level of energy consumption is low and market processes are weak.

(iii) The turnover in energy using machinery, equipment and appliances is low, due to capital scarcity.

(iv) Traditional life styles (eg. cooking) play a very important role.

However, recently several attempts in energy demand management have been initiated in India, as it is found that demand management can shift energy consumption from lower to higher value uses and reduce energy cost of final output. Policy instruments for demand management are usually pricing and fiscal measures, physical controls and regulations and public education.

The pricing policy for energy can ensure adequate supplies if the prices reflect the true costs of supplying the fuels. Fuel consumption to different sets of consumers can be ensured if the prices are equal to the real economic (opportunity) costs when the energy can be traded. If the energy is noncommercial and cannot be substituted, then the price must equal the cost of production or replacement. Analysis for pricing can result in economic pricing that can result in meeting the social/basic needs, financial viability of the project over its life cycle, energy conservation, and consumer protection. Physical controls (curtailing production or imports, rationing) have been found to be effective only in the short term.

While it is true that pricing can allocate resources efficiently for energy demand management, there are special problems with the pricing/market model. The poor and vulnerable will be discriminated by this approach. Those who can pay, can corner energy supplies, thus depriving others. The urban demand for firewood has driven the prices of firewood upward in rural areas, thus depriving many poor families of their basic fuel needs. It has also been found that at low income and consumption levels, price elasticity of demand for energy is low. Higher prices for such people will simply result in sacrifice of other consumption needs in favour of energy. For many poor, the percentage of expenditure on energy in total family budget is growing. With frequent interruptions and supply uncertainities (in kerosene, firewood, LPG) the price mechanism does not work well for the urban and rural poor (World Bank, 1983).

In reality, prices of many energy products are distorted in India. There are a lot of hidden and explicit subsidies. Because of dominant public sector ownership and absence of economic transfer prices, nuclear power, coal, kerosene, transport, solar energy etc. are all explicitly or implicitly subsidised or given tax breaks and concessions. To dismantle the existing price controls and subsidies will be nearly impossible to achieve in the short run. With supply shortages, it would be disastrous and inequitable to do so. If in pricing policy, the government adopts a two stage approach (a) efficiency analysis (b) adjustment for other factors (subsidy, tax policy etc.), then there is a high probability that pricing can serve as a tool for demand management. The price distortion will be specific, direct and intended, to serve larger social objectives (Munasinghe, 1983).

To cite a few examples of demand management would be in order. It has been found that to provide adequate cooking energy to all, controls over cutting firewood or price subsidy is not very useful. Design and diffusion of efficient stoves and public education can be very effective. Subsidy of kerosene has been found to result in adulteration of petrol and diesel and can benefit the rich. Similar is the case with low electricity tariffs. Here is an area where demand management through pricing is not effective.

In the area of Transport, price increases may reduce the demand only in a limited way when the higher costs cannot be passed on to another (eg: personal transport). Shift to more energy-efficient carriers (public transport, coastal shipping, railway), better spatial planning, improved traffic management and design of fuel efficient vehicles may reduce demand in the transport sector. These can be brought about by non price interventions.

In industry, energy intensity depends on product mix, technology, energy sources used, scale of plant and operational efficiency (waste heat, downtime, maintenance and operations practices etc.). Demand management in industry would imply planning for improved energy management, training in operations and maintenance, retrofitting, improved production processes etc. Price increases of energy or tax support for energy savings equipment will have only marginal effects as energy costs as a percentage of total manufacturing costs are usually low and increases can be passed on easily to the customers or absorbed. Supply disruptions like power cuts affect industrial profitability for more sensibly. Presently energy audit in industry and technological improvements are getting emphasis in India (ATIRA, 1979). Overall planning for energy demand management in Industry has not been done so far in India.

Given the structural condition of energy use in India, short term goals for demand management in India can be (besides physical controls or emergency allocation measures) (i) Reduction of energy intensity in industry, transport, construction and cooking by technological development (ii) Improving energy efficiency by pricing and interfuel substitution. Pricing may have some limited impact. In the long run, structural adjustments in the pattern of production and consumption (Desai, 1983) (e.g. share of oil in external trade) and even macro economic adjustments in the growth rate of the economy may be called for to ensure effective demand management. In the long run, use of biofertilizers, information technology and new materials may reduce energy demand. Such technological developments are within the realm of the possible.

In the area of energy demand management, a few specific planning tools used in India need special mention. There are forecasting techniques of the following nature: (a) Multiple regression models that forecast energy requirements in specific sectors (irrigation, household, industry etc.). Sometimes economic models as a simultaneous equation system are also used. (b) Input-output models. The Planning Commission in the formulation of five year plans uses an intersectoral I-O model, which represents the intersectoral flow of goods and services in value terms. Each sector appears twice in the transaction matrix, once, as an intermediary user and once in its role of producer of a commodity. Input requirements and final consumption can be readily analysed from the model. Each row in the matrix shows how the output of a particular sector is used. Each column shows where the inputs used by a particular sector comes from. The Planning Commission, based on this matrix, indicates the overall mix of economic activities to be undertaken in a plan period (Planning Commission, 1980). The energy sector calls for nearly 30 per cent of the allocation in the Sixth Plan. (c) Energy Surveys have become common. Sector or village surveys are conducted to determine the energy use patterns from a sample of the universe, intended for study. From the sample data, demand projections are made (National Council, 1971).

Energy Balance is an accounting table presenting a coherent picture of physical flows of all types of energy, from their origin, through the transformation process to final use. Even though it specifies the interrelationships, it does not show the economic value of such flows nor does it reflect economic relationships within the sector or the socio-economic environment. Even in the physical aspect, it does not provide information on energy reserves or capacity for production. Briefly the model can be represented as :

Production + imports - exports ± stock changes - transformation losses = Consumption of useful energy.

The sources and energy using activities form a matrix. Energy Balance Analysis helps in the rational use of energy (e.g. domestic vs. imported routes of energy transformation or substitution) and in preparation of national accounts. Such analysis gives a synoptic view of the whole sector and is just beginning to be used in India.

Another modelling approach is that of Simulation model of Energy sector. Such a model enables us to study the implications of variations in any part of a system for the functioning of the overall system. Simulation models are mathematical models and we can test the impact of price rise, supply disruptions and fuel substitution etc. The Planning Commission in 1981 (Parikh, 1981) developed such a model. It consisted of (a) A model for generating macro economic scenario (b) a model for simulating sector energy demand (c) a model to understand the conditions under which, energy requirements for economic growth can be met. Simulation models can be very useful to test the sensitivity of various parameters.

With the rising size of energy projects, environmental impact assessment of energy projects is being included in planning studies. An assessment of the near and far future environmental influence of the estimated effluents of the project and of the changed end use consequent on the implementation of the project, is made. The methods used are field studies, interviews, research etc. Many dimensions of the environment are air, quality, water quality, soil structure, cropping pattern, weather conditions, wild life habitat status etc. Recommendations for minimising the negative environmental effects are included in the assessment. A recent example is the environmental impact assessment of the superthermal stations.

Optimisation Studies are also becoming common in energy planning. Refinery products mix optimisation and optimisation of electric energy source use to meet demand over a time horizon subject to a number of conditions, are examples. Linear, Dynamic and Integer programming models have been developed for system optimisation in power sector.

Several of the above methodologies are being used in India to decide on location, size and timing of energy projects. Manpower planning, Import of technology, R & D priorities, Impacts of energy policies, Financial Planning are some of the energy planning models currently in use.

The information base for using these various energy planning methodologies is yet to be fully developed. Social, economic and demographic data of a general nature are available from the Census and National Survey data. National accounts and budget data provide macroeconomic information. Industries surveys and Registration provide special data. Information on noncommercial energy, household energy use and the diversity based on seasonality and cultural variations is not known. The understanding of the relationships that influence energy use patterns is also poor. While data is being collected by many institutions, the depth and breadth required in planning is missing. The possibility of developing alternative energy scenarios for India has to wait till an adequate information base and coordination among planning agencies becomes a reality. A Delphi study for developing such scenarios among experts was attempted sometime ago (Indian Institute of Science, 1975).

The methodologies we have reviewed are largely quantitative. Qualitative methods in energy planning may be equally relevant (Resources for the Future, 1975).

Anthropological information, data generated by participatory processes, negotiation and community consensus and cultural norms are beyond the scope of energy planning now. If we consider that energy knowledge is objective as well as social, the importance of qualitative methods becomes evident. Some methods like C/B analysis and pricing analysis are politically sensitive as they are designed to account for specific group benefits. For example, the use of Bombay High gas in Northern and Central India, pricing of energy for agricultural use, location of nuclear power stations are basically political in nature. Methods like Energy Balance analysis, Rural Energy Surveys etc. are not so politically sensitive as they do not ascribe benefits to any group or region.

The ensemble of methods described here portrays a picture of energy planning in transition. Comprehensive energy planning using a variety of connected methods has not been attempted in India. Hence a holistic picture of energy has not emerged. The nearest to such a comprehensive study has been done in Bangladesh (DeLucia, 1982) connecting various planning studies.

We had briefly mentioned the work of the Energy Survey Committee in the sixties. Subsequently, a Fuel Policy Committee was set up by the Government of India in 1971. It submitted its report in 1974. It consisted of largely experts and some administrators. Based on the economic growth rates given by the Planning Commission, the FPC, developed three energy scenarios with different degrees of substitution of oil by coal, and fuel efficiency. Three different (time trend, regression models and end use or materials balance) methods were used to forecast demand. The FPC recommended that coal should be the primary fuel in the future and oil consumption must be reduced. Specific recommendations about power plant utilization and renewable sources like biogas and social forestry were made. The third major attempt in energy policy formulation is the Working Group on Energy Policy for the Sixth Five Year Plan. It was set up in 1977 and submitted its report in 1979. This planning exercise also attempted two forecasts (reference-status quo and optimal level). It was largely conservation oriented and made a large number of recommendations regarding alternative energy policies, renewable energy etc. None of the three attempts questioned the role of nuclear power.

In terms of utlization by Government, the Energy Survey Committee's work was not utilised well due to lack of awareness of the energy problematique. The FPC suggestions had a better impact and fuel substitution efforts were started. Some organizational changes were made in Government also. A Ministry of Energy consisting of the departments of coal and power were created. An Advisor for Energy was recruited in the Planning Commission. The Working Group had more impact. Conservation and renewable energy were given a big boost. The Ministry of Energy was strengthened with the addition of Department of Petroleum and a full fledged new Department for nonconventional sources of energy. In 1982 an Advisory Board on Energy was established to comprehensively view the energy sector. Great challenges, however, remain in decentralised energy planning (at state/local and sector levels), change in resource allocation and mix of economic activities and user awareness and perception. The coming decade might will take us in new directions in energy planning.

Energy planning has an important dimension which has not had adequate attention in India. I refer to planning for the structure of the energy sector. The growth and development of the energy sector has been characterised by the dominance of the public sector (Johnson, 1980). Resource survey and production, education, research and development, generation and transormation, equipment manufacture, distribution, financing of all major commercial sources are in public sector owned by central government. Only electrical equipment manufacture (cables, engines, motors and appliances) and the large, pervasive noncommercial energy sources are not in public sector. Investment outlay in the energy sector are approaching 40 per cent of the total plan outlay. The market concentration, centralisation and ownership, control of the union government in energy sector have become "hegemonic". Even in consumption (Railways, central government services) the Government is dominant. There are strong interrelations in product and factor markets. Some energy products have same factor markets but different product markets. Yet others have same product markets (in terms of substitutes) but different factor markets. The role of the market place is very limited in the energy sector (barring a selective role in equipment and imports). The state and local governments have a marginal role in overall energy planning (except for state electricity boards). Capital expenditure in states is also controlled by the Planning Commission. Compared to thirty years ago, the power of the central government (no pun intended) in the energy sector has increased enormously. Community and voluntary organizations have a very small role in noncommercial energy. The balance between State, Market and Community, so vital for orderly development of energy, has been distorted in favour of central government. Just as the dominance of market processes will accentuate inequality in society, the dominance of state will create a new kind of oppression, dependence, sterility and inefficiency. With the Government everready to absorb losses and provide subsidies, inefficiency and waste have grown.

The evidence of State Electricity Boards alone is sufficient. If we measure the performance of the energy sector enterprises in public sector, in terms of economic viability (profitability and generation of internal funds for growth), innovation, product diversification employment, productivity and international competitiveness, the record is quite poor. Apart from oil which has a certain dynamism, coal and power are permanently being treated as sick needing massive infusions of subsidies to absorb losses. Low capacity utilisation, low personnel morale, rigidity in decisions, ineffective regulatory systems, absence of energy planning of any kind at local government level characterise the state energy sector today. There is excessive concentration of R & D in atomic energy and very poor R&D in other energy institutions. Energy planning capability at state, district, city government level is negligible.

It is clear that there is a need for structural reform over the next ten years. Yet, the directions for change are not clear. What roles for the market, the state and the community in the future? In which areas are they relatively more effective? When should the government withdraw? What are the structural arrangements for macroeconomic management, competition and regulation? What should be the linkages between service providers, equipment manufacturers, resource producing enterprises, education and R & D institutions, electricity boards, financial institutions and the regulatory, policy making agencies? Can we prevent the energy sector becoming a permanent drain on the economy? Structural planning in energy is urgently needed. Such planning should go beyond organizational arrangements and look at networks, economic structure, policy and environment, informed by a sense of history. India still seems to be unaware that structure determines strategy.

Inter organizational relationships in energy as a part of structural analysis, is very important. Presently each organization (ONGC, Coal India and State Electricity Board) is trying to optimise its performance, given the constraints. The problem is not merely one of coordination among them and development of congruence of interests. There is some evidence of deeper links between Coal India Ltd. and Railways or between Coal India and the cement industry. Poor linkage will result in ineffective flow of information, material etc. between them and the overall performance will suffer. The interorganizational planning can follow any of the following models or in combination:

(a) Exchange model focusing on flow of inputs, pattern of interaction, interdependency, coordination and feedback relationships.

(b) Political model focusing on conflicts in relationships, resource control and power distribution issues, and

(c) Dialectical model focusing on mutual interaction between resources/environment; society and energy strategies. Thus inputs, networks and output are mutually forming and contingent on each other.

The traditional government approach to the inter-organizational problem - setting up a holding company, committee or coordinating body - will not work. We need to critically look at the network and develop organizational forms appropriate to the task of managing a mix of policy instruments and institutions. Decentralisation and centralisation, the market, state and the community, large and small all need to be balanced.

We finally turn to the political economy of energy planning. Energy planning looked at, in a political economic framework, will mirror social reality. The social structure has primacy in this dialectical relationship between society and energy. Given the existing inequalities in society, energy sector interventions will simply reinforce and accentuate the inequality. In spite of desirable goals and well meaning strategies, the rich, the urban, and some sectors of the economy will benefit at the expense of others. The dominance of economists and engineers in energy planning, the dominance of state in energy sector, and the domination of the positivist tradition in energy planning indicate this. Energy use surveys reify the present pattern of consumption and legitimate the status quo. By aggregating individual consumption figures, they focus on surface phenomena. Energy planning in India largely ignores the historical processes that generated these patterns and thus reifies energy patterns that perpetuate energy inequity. Energy planning in the positivist tradition is rigorous and generates useful, objective and synoptic data. Yet it collapses processes (history) into results and quality into quantity. People cannot participate in the bureaucratic-technocratic energy planning system, which consider them as passive consumers of energy, those that "emit" energy consuming behaviour that can be captured by models.

A political-economic analysis of energy planning revelas it to be a fragmented, specialised activity done by professionals. It is often assumed that more energy planning, more rigorous methods will solve our energy problems. It is possible, as Ivan Illich has done, to view energy planning as iatrogenic - causing problems.

Energy planning knowledge needs to become critical and self-reflective. A broad structural understanding of our condition may enable us to use energy planning critically and progressively. The review in this paper hopefully will be of some assistance in that endeavour.

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