

Issues in Energy Supply and Demand Management—The Case of Arunachal Pradesh

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It is a paradox that Arunachal Pradesh which has vast potential of energy generation, is having a per capita energy consumption as low as 55 KWH. This low level of per capita energy consumption is one of the important reasons for the low level of economic development of the state. Its per capita power consumption is 10 KW which is the lowest among the North-Eastern States, although its hydro-power potential estimated to be 30,000 MW, happens to be one-third of entire hydro-power potential of the country. More than 90% of the energy requirement in the state is met through non-commercial energy sources dominated by fuelwood. Consumption of commercial fuels like electricity, kerosene, diesel, petrol, etc. is generally confined to the urban areas; their availability in rural areas is limited due to remoteness and high infrastructural costs involved. With the rapid growth of population¹ and its consequent stress on natural forests, the forest cover is depleting fast which has its environmental implications.

Thus, in view of (i) its typical energy availability and demand situations different from the plains, (ii) the necessity of breaking the vicious circle of low energy consumption and low economic development, and (iii) making the developmental process environmentally sustainable; a need to manage its energy resources becomes very much imperative.

Efficient planning of energy resources requires a proper management of energy supply and energy demand situations. At a given level of demand, energy supply is a function of a number of variables and so also the energy demand at a given level of energy supply. Here we do not want to go to the details of such functional relationships. What we want to discuss here, is the need and measures to manage energy supply and demand situations. A careful study of the energy situation in Arunachal Pradesh reveals that there is enough scope of improvement (through inducement or intervention or both) in both the fronts, i.e. supply and demand.

SUPPLY SIDE MANAGEMENT MEASURES

The supply front needs emphasis because:

(i) There is continuous shortfall in power availability as the power requirement is calculated to be more over the actual generation.²

(ii) To undertake evaluation of the marginal costs of production and distribution of alternative sources of energy taking into consideration the social costs of production and distribution of various sources of energy so as to ensure optimum social welfare.

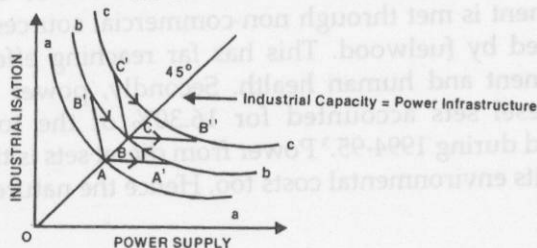
(iii) To break the vicious circle of low energy consumption—low level of development in the context of scarcity of resources.

As mentioned earlier more than 90% of the energy requirement is met through non-commercial sources of energy dominated by fuelwood. This has far reaching effects on the environment and human health. Secondly, power generation from diesel sets accounted for 16.30% of the total power generated during 1994-95.³ Power from diesel sets is the costliest and has its environmental costs too. Hence the nature of energy

supply needs a change. Till date no meaningful exercise on the social costs of production and distribution of various sources of energy has been undertaken in Arunachal Pradesh. Non-availability of data denies this author to go for effective quantification exercises in this regard. However, some such exercises undertaken by economists/technocrats in other states can be cited to broadly justify that the economics of energy production doesn't support the production from diesel or thermal power plants⁴ and more so in Arunachal. When one takes into consideration the environmental and gestation cost, the case of production of power from these sources becomes all the more weak. This suggests that renewable sources of energy supply should be given priority in Arunachal Pradesh in the coming days.

Secondly, the state suffers from the vicious circle of low energy consumption-low level of economic development. Since the level of industrialisation (primarily because of low level of induced investment) is low and there is resource scarcity, Hirschman's model⁵ of unbalanced growth is an appropriate model for Arunachal Pradesh to follow in this context. The best way to break this circle is to deliberately unbalance the economy of the state by creating an excess of power supply (social overhead capital) over industrial capacity (directly productive activity). Once the level of power supply is increased either by autonomous investment or induced investment (for induced investment in the power sector, measures such as tax concessions, subsidies of various types are to be taken) or both, this would encourage the industrial sector to grow by way of establishment of small and medium scale industries. Such a model is described graphically as follows:

FIG. 1
Strategy of Development via excess of
Power Supply over Industrialisation



In this diagram, investments on power supply are measured along the horizontal axis and investments on industry are measured along the vertical axis. The isoquants a, b, c show various levels of industrial and power investments which give the same Gross State Domestic Product (GSDP) at any point of time. Higher isoquant shows higher levels of GSDP. The 45° line shows balance growth of industry to power sector. The path of development through excess of power supply is A A'B B''C. When the state increases the power supply from A to A', the induced industrial investment increases to B' until the balance is restored at B. At B the state's economy is on a higher level of output. The implication of this model is that since this state faces the scarcity of financial resources required for simultaneous development of all the sectors of the economy and it also has a very low industrial consumption⁶; acceleration of the developmental process will become a possibility by deliberately increasing the supply of energy.

Other measures to strength the supply of energy in the state are to formulate suitable tax and subsidy policies to encourage production of the chosen source of power which can ensure social optimality, to promote social and political stability in the state and government etc. The present taxation and subsidy policies need to be more target and source specific instead of being general in nature.

DEMAND MANAGEMENT MEASURES

In a state like Arunachal we presume the energy services to be income elastic. Assuming a very conservative income elasticity of energy i.e. 1.5 along with an annual per capita growth rate of 2%, the annual growth in energy demand comes to 3%. Adding to it the annual growth in population which as per 1991 census is 3.2%, energy demand can be assumed to grow at 6.2% a year. This estimated growth rate of 6.2% is very high compared with the growth rates of energy demand in developed countries of the world. This plus other deficiencies necessitate the development of a proper demand management strategy. Demand management is necessary for two reasons: (i) to promote energy efficiency, i.e. to reduce energy intensity,

(ii) to induce a shift from high cost (private + social) sources of energy towards cheaper and environmentally sustainable ones.

Although apparently it seems that the scope of the former measure is very limited, a deep understanding of the rural energy consumption pattern brings out its importance. There is no doubt about the scope of reducing energy intensity in household, commercial, building, transport and agricultural sectors in the state. More important is the existence of vast scope of energy efficiency improvement measures (i.e. energy conservation) in the rural sector of the state where fuelwood is the principal source of energy for cooking and heating purposes. Substitution of firewood by other renewable sources of energy increases energy efficiency or reduces energy intensity. This can be properly implemented along with other measures if the education and awareness level of the rural masses gets improved and the source of energy supply becomes stable.

THE VIABLE ENERGY PLAN

Given the various limitations, the viable energy plan for the State of Arunachal Pradesh should be a decentralised energy plan having multiple facets (such as efficient and stable energy provision at the local level, promoting afforestation and environment, conserving energy, creating employment and social welfare) in the overall context of increasing the energy supply and promoting energy conservation in the state. The intervention plan should (i) be a combination of energy systems each of which meets the needs of different end users, improves the energy situation by reducing the consumption of fuelwood and other commercial fuels like diesel, kerosene and replacing them by the use of the existing untapped potential of renewable energy sources, (ii) promote rapid development of the state by consciously unbalancing the state's economy with an excess of appropriate and cost effective energy sources in view of the resource scarcity. Renewable sources of energy should be emphasised as (i) the marginal cost of production and distribution of this source at present is lower in many areas of the state in view of its tough topography, scattered nature of

the inhabitants, (ii) it ensures maximum use of local resources and security of energy supply, (iii) it is practicable going by the quality of the technical personnel available and working in the energy sector of the state, (iv) it is culture compatible.

The viable energy plan should also have the in-built flexibility of gradual shift from one source of renewable system to the other if conditions of cost effectiveness and sustainability so demands in future. For the present, improved Chulha and bio-gas plant should be confined to those areas where the forest cover is rich and biomass generation is abundant. Solar energy system should be created in those hilly areas where bio-gas plants are technically not feasible due to climatic reasons or the villages being scattered widely or there is absolute absence of communication facilities.

Among the renewable sources, micro-hydel project should be given priority for areas where water flow is abundant because of the following reasons: (i) It is cost effective in relation to other sources of energy. (ii) It caters to the needs of small industry as well as household and commercial institutions. (iii) It requires moderate investment in relation to large hydel or thermal plants. (iv) It has lower training cost in respect of training to the technical staff. (v) It has low gestation period. (vi) It generates external economies such as creation of minor irrigation infrastructure and rural water supply facilities. (vii) It is suitable to grid/non-grid connection. (viii) It has low transmission loss and thus low distribution cost.

The second element of the viable energy plan is the conscious increase of power availability through undertaking of more hydel projects, i.e. both large and mini/micro so as to unbalance the state's economy. This will in the long-run induce industrial activities to appropriate these surplus power capacities, taking the economy to new and higher levels of growth.

CONCLUSION

In a state like Arunachal Pradesh the prime objective of the energy resource management strategy should be to achieve sustained self-sufficiency and cost effectiveness in energy

consumption, and to promote rapid sustainable economic development. In the context of these twin objectives, the viable energy resource management plan for Arunachal requires suitable measures to be initiated both in the supply and demand fronts. Although there are a number of variables and factors governing the supply of energy resource in the state, it is the marginal cost of production and distribution of energy, government's policies concerning taxation, subsidy and environment safeguards, and the desired level of industrialisation are the three important variables to be given stress initially. On the demand side, *ceteris paribus*, reduction in energy intensity in household, institution and industry levels, level of security desired, inducement through pricing to shift demand from high cost sources towards cheaper sources, and education and awareness level are the factors/variables to be given emphasis. Finally, manipulations of these factors/variables on the supply and demand fronts would result in a viable energy plan which makes it imperative to develop a scheme of renewable energy system with provisions of in-built flexibility and generation of excess of cost effective power potential to promote rapid economic development of the state in the context of resource scarcity.

NOTES AND REFERENCES

1. The annual rate of growth of population in Arunachal Pradesh is 3.2 per cent as per 1991 census.
2. As per data furnished in Economic Review of Arunachal Pradesh 1995, Government of AP, it is mentioned that the shortfall in power was of the level of 17.80 and 27.41 MW respectively during the years 1991-92 and 1993-94. It is also mentioned in this publication, "with the present generation capacity available the shortfall of power is likely to be increased to a great extent by the end of 8th Five Year Plan."
3. Calculated from statistics provided by Govt. of Arunachal Pradesh in its Economic Review of 1995.
4. Vardarajan (1993) in Punjab found that in 1988 the cost of production of power without taking into consideration environmental and gestation costs from diesel was Rs. 2/kwh, from coal Rs. 1/kwh, from micro-hydel Rs. 0.47/kwh, from bio-mass based plants Rs. 0.60-1.00/kwh and from solar thermal power plants (30 MW) Rs. 1.50/kwh

- respectively.
5. Hirschman, A.O., *The strategy of economic development*, chapters 4-7.
 6. Industry's consumption of power during 1994-95 was 10% of the total annual consumption of power in the state.
 7. Energy intensity is defined as the amount of energy used per unit of activity.

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