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APPROACH PAPER ON ENERGY IN THE CONTEXT OF
URBANISATION

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by

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The subject of energy in the context of urbanisation has to be seen on a broad canvas, since the energy implications of different forms of urban growth and development present serious challenges to the energy sector in financial, economic, technological and environmental terms. Unfortunately, not much quantitative work has been done in this country to assess the overall energy implications of different patterns of urbanisation, not only with regard to future possibilities but also on the basis of past experience in urbanisation in this country. Most of the literature that exists on this subject, unfortunately comes from work done in the industrial nations. The relevance of this work hardly goes beyond raising some conceptual questions, and in no way provides an empirical basis for studying the problem in India.

STATE OF THE ART.

The state of the art of energy in the context of urbanisation is not precisely definable. Studies on urbanisation have not generally dealt with energy questions per se, and at best one can draw some very tentative conclusions and inferences from the material that exists by exploring the linkages that exist between various facets of urbanisation and the energy sector. The subject has been tackled in a limited manner in the reports of the Working Group on Energy Policy, the recent report of the Advisory Board on Energy and the report of the National Transport Policy Committee. But these do not deal with the subject within a clearly defined and precisely articulated framework. The studies on energy consumption themselves, which have attempted to generate data, have also not looked at energy in the context

of different aspects of urbanisation. For instance, the 1978-79 survey of household energy consumption conducted by the National Council of Applied Economic Research (NCAER) merely documents household energy consumption data separately for the urban and rural households in the country, but does not classify them by different income levels. Consequently, the resources used in this study have not been utilised to establish how energy consumption varies with different types and sizes of households. We do not, for instance, know whether, all things being equal, a household of a particular size and at the same income level consumes the same quantity of energy in the town of Ghaziabad as, say, in the city of New Delhi. In the absence of primary data it is extremely difficult to arrive at any conclusions on the implications of different strategies in urban development in the future.

Again, in the case of transportation services within urban centres, there is very little authentic and empirical information available on the pattern of transportation in particular types of urban structures, much less the energy implications of these transportation patterns. Undoubtedly, there are studies that have been carried out by metropolitan bodies dealing with transport questions, but none of them appear to have been published. For obtaining data to answer these questions one would have to rely solely on access to such studies, which may be available with organisations like DTC, BMRDA, The Calcutta Metro Authority etc.

In conclusion, the state of the art in the context of India is rather diffused and the first step in coordinating a study of this subject would be essentially to create ab initio a state of the art on the subject.

THE PRESENT TRENDS.

The present trends in energy consumption can best be discussed in terms of the following subjects:

1. Demand for energy.
2. Options for energy supply
3. Urban energy distribution issues.
4. Environmental questions related to energy.

Each of these subjects can be explored in further detail as follows:

1. Demand for energy:

The demand for energy needs to be studied along sectoral lines and in the context of the influence of different forms of urbanisation on sectoral variables. The major sectors in which energy is consumed include:

Households - The major variables relating urbanisation characteristics in this sector include:

- Income
- Relative prices of fuels
- Climatic factors
- Prices and availability of commercially prepared meals and food (e.g. canteens, restaurants, dhabas etc.)
- Architectural characteristics and building styles, Prices of energy using appliances.

Each of these features is a major determinant of energy demand in the household sector. Some variables influence demand for both commercial as well as traditional fuels, such as the income level of

the household. For instance, low income slum dwellers are likely to use commercial fuels such as kerosene only to a limited extent for lighting purposes but would rely on supply of fuelwood, waste materials, etc. for meeting their cooking needs. On the other hand, the prices of energy using appliances would affect only the use of energy forms like electricity, LPG etc. Given the fact that there are substantial differences in energy consumption levels and patterns of use between urban and rural households, it would be fair to conclude that the extent of rural immigration that takes place into urban areas in the future would influence the pattern of energy consumption quite definitely. Rural immigrants take long periods to shed their habit of using fuelwood for cooking.

Transport Sector - The demand for transport services is perhaps the most susceptible to policy direction and public investment decisions. Transport also represents a very large energy consuming sector in total urban energy consumption. This sector also displays a very wide variation in energy use per unit of service provided, say, per passenger kilometre. Energy consumption in this sector would not only be determined by the mix of vehicles and transportation technology used, but also by locational characteristics of the urban structure itself on account of variations in the location of major employment sectors, shopping and commercial districts, schools, entertainment centres etc. It may also be mentioned that this is one sector in which without proper empirical studies conclusions cannot be developed with any degree of reliability. Typically, demand for energy would be determined by

1. - Urban structural characteristics
2. - Income levels
3. - Investments in public transport
4. - Transportation technology

Industrial Sector - Energy demand in the industrial sector is dependent on zoning restrictions, industrialisation policy and the actual establishment of industry within urban centres. This is perhaps the easiest sector to handle in an assessment of energy demand in a specific urban setting. There are nevertheless serious data deficiencies with respect to small industrial establishments which very often use not only commercial forms of energy but also traditional fuels like firewood etc. In the Union Territory of Delhi itself, for instance, it is estimated that one hundred thousand tonnes of fuelwood are consumed annually in industrial units.

Commercial Sector - The commercial sector in urban areas consumes significant quantities of energy and this again would depend on the policy of urbanisation followed by authorities responsible for urban development. For instance, the expansion and growth of banks, shopping complexes, offices, hospitals, schools, restaurants, hotels etc. has a direct and significant effect on demand for energy in this sector. Undoubtedly, some amount of empirical evidence would be available on this sector especially in relation to the population in different urban centres and the variations in commercial activity and energy use that are normally seen in practice. This is another sector for which empirical data is deficient and where some norms from

existing studies may have to be used in order to arrive at the estimates of demand for different types of urban centres.

2. Supply options.

Once the demand for energy for different types of modern urban establishments has been estimated and the variations computed in relation to variability in influencing factors themselves, the supply implications need to be carefully evaluated in quantitative terms.

The issues that relate to energy supply are as follows:

1. Determining the optimal mix of energy sources for specific levels of enduse on the consuming side. This really is a function of technologies and relative economics. For instance, to meet the demand for hot water in the household supply policies need to evaluate economics of solar water heating versus electric water heating versus the use of other fuels for this purpose. Investment policies would be effective only in combination with coordinated promotional measures, incentives, pricing policies etc.

2. In the case of electric power in particular, the problem of peak demand is assuming growing importance. Hence investment policies need to be established in relation to trade-offs with investments for flattening the demand curve itself, again by using a combination of pricing and non-price measures.

3. The problem of traditional fuel supply has to be seen not only in the context of urban demand but also the effect supply of traditional fuels would have on the rural areas from which the supplies originate.

4. Future urbanisation must also contend with the development of renewable energy technologies, and R&D policies and investments could be established in consonance with future goals. Also important in several parts of the country is the question of insulation and building standards etc. for better daylighting, heating and cooling etc.

3. Distribution of energy supply.

Distribution problems are critical to proper urban planning. The types of issues and systems that need to be evaluated in relation to the size and spread of urban habitations are:

1. Centralised versus decentralised packaging/supply of fuels.
For instance, for supply of LPG or other forms of gas, issues to be considered are whether bottling of cylinders or piping of supplies is the preferred option. There are several degrees of decentralisation, such as providing storage and decentralised supply facilities in large buildings and major consumption points.
2. Storage facilities, such as in the case of fuelwood storage centres or coal dumps for supply of soft coke, provision of oil storage tanks etc. These become important elements in the initial planning or planned expansion of urban centres.
3. In the future there would be other options such as the supply of photovoltaic power to households versus distribution from conventional grid systems. In either event facilities, space requirements and other physical features would have to be planned for accordingly.

It should be reasonable to expect that information on some of these questions is readily available with energy supply organisations and metropolitan development organisations.

4. Environmental issues.

The major source of environmental damage is the use of energy be it in the form of fuelwood being burnt in jhuggies and slums, the use of two-wheeler and three-wheeler transport or industrial pollution from boilers, furnaces and power plants. The effects of different types and levels of energy supply and consumption on the environment in relation to spatial factors need investigation. The Central Board for Control of Pollution has a fair amount of data which can be analysed in depth for assessing some of the relationships underlying these influences. This is an area in which very little rigorous work has been done, and with the development of suitable models it should be possible to forecast and project future environmental conditions related to specific energy consumption patterns. TERI is in the process of setting up a collaborative arrangement with a West German research organisation called INNOTECH, which would be able to provide considerable technical data on air pollution and methodologies for modelling these in typical urban situations.