A STRATEGY FOR RESOLVING INDIA'S OIL CRISIS

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INDIA, like all oil-importing developing countries, is heading to a catastrophe due to the post-1973 escalations in oil prices. Unfortunately, most of the measures to tackle this crisis have been based on a narrow sectoral approach ignoring the interdependence of energy-consuming sectors.

This paper is an attempt to explore the interdependence of the transport and household sectors and to show that the resolution of the oil crisis lies in an alternative two-pronged strategy involving measures to be taken in the household sector.

India's oil consumption has been steadily increasing—the average annual compound rate of growth has been about 7% since 1975–76 (*i.e.*, after the 1973 oil-price hike !). Indigenous production only accounts for about one-third of the country's total consumption which was about 33 million tonnes in 1980. Since two-thirds of the country's requirements are imported, the country's oil import bill has been escalating rapidly (approximately Rs. 6,000 crores in 1980), and has reached about 80% of the estimated total foreign exchange earnings in 1980–81. This already impossible situation can only worsen—hence, it is a matter of the country's survival to formulate and implement a strategy for the resolution of the oil crisis.

About 80% of the country's oil is used in the transport (~60%) and household (~20%) sectors. The transport sector uses motor gas (petrol), aviation transport fuel (ATF) and diesel—in 1978, these accounted for about 12%, 9% and 79% of the consumption in this sector. Diesel is used by trucks/buses, railways and shipping, but trucks (64%) and buses (22%) consume about 86% of the total diesel in the transport sector.

Diesel locomotives haul about 37% of the country's freight whilst consuming about 11% of the diesel used in the transport sector, in contrast to trucks which consume 64% of the diesel (6 times the railway freight consumption) to carry 36% of the freight. This only illustrates the well-known energy efficiency of railway transport compared to truck transport. Despite this, the share of the total freight carried by railways has been steadily decreasing—in 1960–61, railways

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carried 84% of the freight; today, the figure is about 64%.

Truck transport has been able to increase its share of freight mainly by increasing the average lead distance over which it carries freight. It is well known, however, that the costs of both truck and rail transport (in terms of resources utilized to move any commodity) increase almost linearly with distance, but truck costs, which are lower than rail costs at small distances, rise more rapidly with distance and exceed rail costs at large distances. In other words, there are break-even distances below which truck transport utilizes less resources, and above which rail transport is more economical in terms of resources. These break-even distances decrease as the diesel price increases—but, on the basis of a 50% increase over 1979 diesel prices, the break-even distances are between about 100–130 km depending upon the commodity. In fact, the average lead distances over which trucks are presently carrying freight are 3–4 times the break-even distances.

The main reason for this proliferation and expansion of truck transport—apart from factors such as shortage of wagons, delays, inefficiency, etc., which are not unavoidable features of railway transport—is the fact that financial costs to the truck operator are lower than the resource costs to society because of significant subsidies. An indication of the element of subsidy is the low price of diesel relative to petrol. In India, diesel has been only about a third to a half of the price of petrol, in contrast to industrialized countries where diesel and petrol have almost the same price.

An apparently obvious device to shift freight traffic from truck to rail is to increase the price of diesel so that, for instance, it is on par with the price of petrol. But, this is not possible at present because the price of diesel is pegged at the price of kerosene which is also a middle distillate in refineries like diesel and substitutable for it in diesel engines. In other words, if diesel prices are increased without equal increases in kerosene prices, trucks shift to kerosene—as has been the country's experience in the recent past. Further, kerosene prices cannot be increased without causing great hardship to the poor because, at present, kerosene is used almost wholly in the household sector.

Out of this household consumption of kerosene, about 70% goes for lighting and the rest for cooking. 87% of rural households and 38% of urban households, together constituting three-quarters of the country's 116 million households, depend wholly on kerosene for lighting. The amount of kerosene used is large—about 4 million tonnes in 1978–79 in comparison with about 10 million tonnes of diesel. Further, about 40% of the country's kerosene is imported. The consumption for lighting is, on the average, about 2·2 litres/month/household. Kerosene lamps have an extremely low luminous efficiency [output of light energy (in lumens) per unit of energy consumed in the lighting device]—the efficiency of electric bulbs (incandescent lamps) is about 200 times the efficiency of kerosene lamps.

Though electric lighting will result in a dramatic improvement in the quality of life, the situation with regard to electrification of *homes* is alarming. (*a*) All the 2,700 towns (with a population above 10,000), but only 44% (less than half) of the 567,000 villages have been electrified. (*b*) Only about 16% of India's electricity goes to rural areas. (*c*) Even this rural electricity is used primarily (to the extent of 87%) for agriculture (pumpsets) with only 13% being used by households—hence, rural electrification has mainly served the pumpsets of the more affluent farmers. (*d*) The percentage of households electrified in electrified villages is only about 14%. (*e*) While the number of new electricity connections increases at the rate of about 1 million households per year, the number of new households increases at the rate of about 2·2 million households per year, *i.e.*, the number of unelectrified homes is continuously increasing despite the decreasing number of unelectrified villages.

The first prong of an alternative strategy is to electrify all homes and provide them with electric lighting. Kerosene will then become unnecessary as an illuminant—thus removing the constraint on diesel prices which can then be increased, and for instance made equal to petrol prices. If, in addition, the permit system for trucks and buses is designed and enforced to keep these vehicles within their break-even distances, there will be a drastic reduction in oil consumption. The National Transport Policy Committee has shown that, using realistic estimates of freight traffic, the projected diesel consumption for the year 2000 decreases from about 30 million tonnes to about 14 million tonnes by shifting to rail 75% of the inter-regional traffic moving by road beyond break-even distances (calculated on the basis of $ 30 barrel oil prices). But, oil prices may go up from $ 50 to $ 100/barrel in the next few years, implying that break-even distances will be even lower; and a much greater percentage, say 95%, of inter-regional freight traffic allocable to rail can be shifted to rail—hence, much greater reductions in oil consumptions can be achieved. Thus, it seems possible to bring oil consumption to within the capability of indigenous production which is about 13 million tonnes/year.

Even the major reduction in oil consumption achievable by the first prong of the strategy may not be adequate because (*a*) intra-regional or short-haul traffic is best achieved by road transport and (*b*) for a sustainable future, the dependence of road transport must shift to renewable energy sources, *i.e.*, to alternative fuels. Hence, the necessity of the second prong of the strategy.

Of the various renewable energy fuels, those dhat can be derived from biomass, *viz.*, procucer gas, methanol, biogas and ethanol—tan easily be used in transportation vehicles. Ethanol—the Brazilian response to the oil problem—is produced from crops like sugarcane which require good agricultural land, leading to serious competition with food production—hence, ethanol is an unsatisfactory solution for a high population density country such as India. Biogas is a gaseous fuel which cannot be easily liquefied—it is only suitable for transportation over short distances from the biogas plant. The only feasible alternative fuels, therefore, are producer gas and/or methanol (which is obtained from producer gas). In fact, producer gas generated *in situ* with charcoal gasifiers was used in buses and trucks throughout the country during World War II.

But, both producer gas and methanol require wood resources, and the wood crisis in India is just as serious as the oil crisis. At present, about 130 million tonnes of firewood per year are consumed for cooking, and it is well known that firewood is becoming more and more difficult to produce. Hence, any attempt to use wood for producer gas and/or methanol in trucks will create even greater shortages of firewood and aggravate the problems of the poor for whom it is the main cooking fuel.

Firewood, however, is not an efficient cooking fuel—the efficiency of firewood stoves (chulas) is only about 5–10%. More efficient cooking fuels will not only provide greater convenience to housewives, but also conserve firewood. Fortunately, India has a large number of cattle—the country's human–cattle ratio is abovt 2·3. The large amount of cattle waste can be used to generate biogas through anaerobic fermentation, and this biogas can be supplied to *every rural home* to meet its cooking needs (about 0·87 m^3/household/day). The cooking needs of *urban* homes, which are now being met by firewood, kerosene, soft coke and LPG (used in 73%, 17%, 5% and 5% of the homes respectively), can be met, for example, by piped mixtures of sewage, coal and producer gases. If gaseous cooking fuel is thus provided to all homes, not only will the 30% of the kerosene presently used for cooking become unnecessary, but the 130 million tonnes of firewood now being used for cooking will become available for other purposes, and in particular, as a renewable biomass fuel.

Out of this 130 million tonnes of firewood, about 75 million tonnes is sufficient to completely replace (after considering efficiency losses) the 10 million tonnes of diesel now used in trucks and buses.

Further, water-lifting pumpsets can be run on producer gas or methanol, and the 4·4 million diesel pumpsets projected for the year 2000 (present number = 2·7 million) would only consume about 16 million tonnes of wood to substitute completely for the 3·5 million tonnes of diesel which they would require. Also, if no further electrical pumpsets are connected beyond the present 3·6 million, and the anticipated increase of 7·4 additional pumpsets by the year 2000 are run on producer gas, about 27 million tonnes of wood are required. Thus, a total of 43 million tonnes of wood are sufficient to replace all the diesel that would be used in diesel pumpsets as well as the 17 TWh of electricity that would be required to run the 7·4 million extra pumpsets that are expected to be installed between now and 2000.

Hence, the 130 million tonnes of firewood released by providing sophisticated gaseous cooking fuels to *all* homes is more than the 118 million tonnes of wood required for all diesel trucks and buses as well as all the diesel pumpsets and additional electric pumpsets. In fact, once the pressure on trees as a source of cooking fuel decreases, the conditions for growing energy forests will be drastically improved leading to a much greater availability of firewood.

Finally, the 17 TWh of electricity saved by not increasing the number of electric pumpsets beyond the present number is only a little less than the 21 extra TWh which would be required to electrify all the unelectrified homes in the country. Thus, the net increase in electricity consumption by electrifying all homes and keeping electric pumpsets at their present number would be 4 TWh in 2000. It is not at all essential that the extra electricity for home electrification should come *via* grids from centralized generation—decentralized generation from local sources such as biogas gensets, microhydroelectric plants and energy forests can make a major contribution.

The two-pronged strategy described above shows that by the provision of electric lighting and efficient gaseous fuel to *all* homes, the country can move towards a virtually oil-free road transport system along with a dramatic improvement in the quality of life for its people. In fact, it appears that the country has been engulfed by a grave oil crisis because it has ignored two crucial basic needs of households: efficient energy sources for lighting and for cooking.