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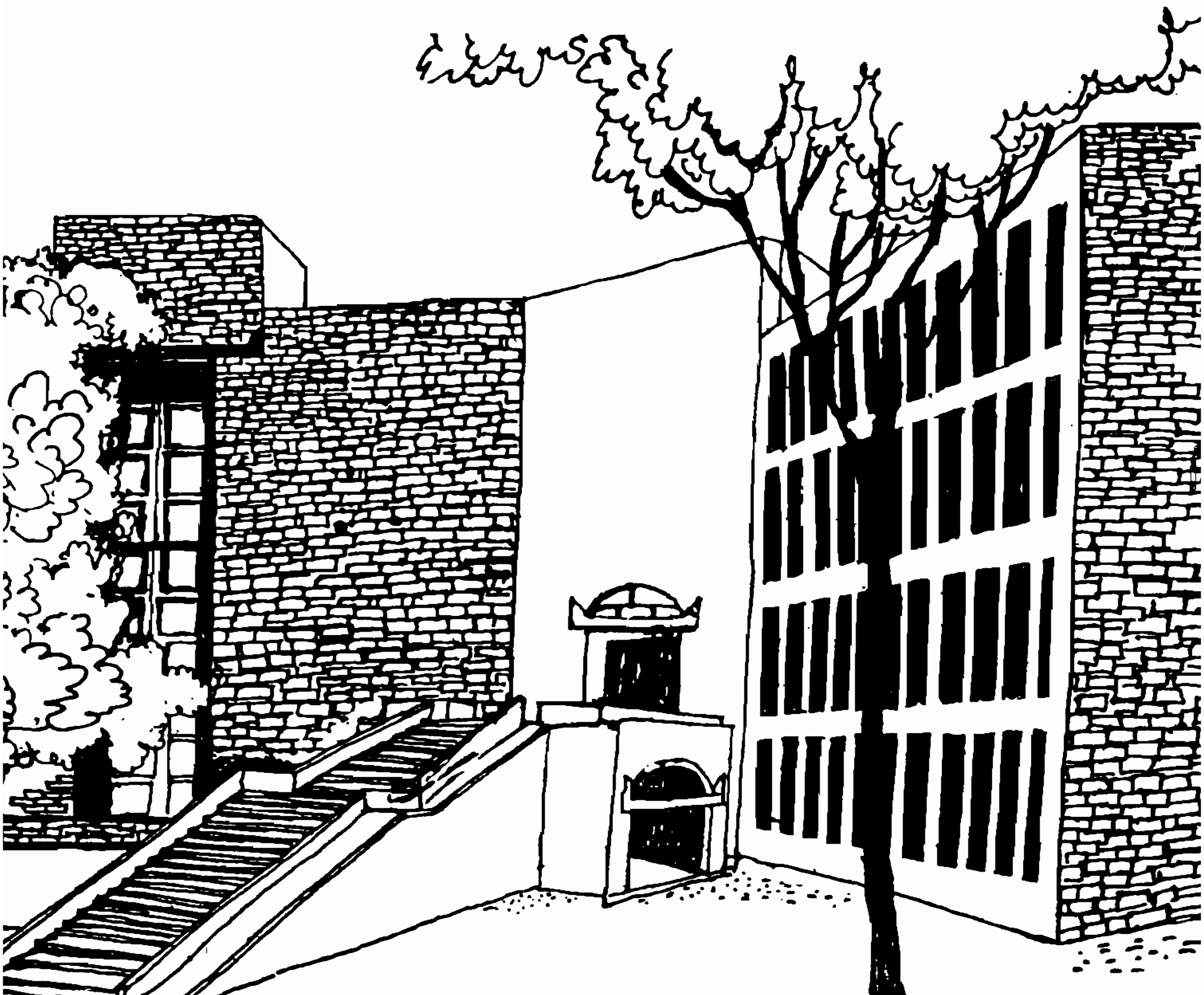

The Political Economy of Electric Power in India

by

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Abstract

Since the cancellation of the Dabhol Power Project (DPP), which was being set up by the Enron Corporation and its associates, the debate about electric power in India has come into the public view, raising hopes that corrective measures can be taken to have a viable, cost effective and growing power industry, that is so vital for an economy like India at its present stage of development.

Several constraints to the healthy growth of the sector had that been building up are uncovered: the inability of the state sector to discipline its management and work force, large scale corruption and leakages, load and system imbalances brought about by inadequate investments in distribution systems, and in hydel capacities. The bulk industrial consumers being increasingly left to fend for themselves through captive power generation, as also the political inability to raise the price of power for the household and the agricultural sectors have further contributed to the structural weakness of the SEB system. In the nineties these have acted to result in a dangerously slow growth in the addition to capacities. The problem was compounded by the severe resources 'constraint' of the state, due no doubt to its commitment to cut the budget deficit. The axe has fallen severely on capital expenditure by the state for capacity creation in not just power but in many infrastructural areas. These were sought to be remedied through the policy of private participation in the form of the Independent Power Projects (IPPs). A critical examination reveals that there are many dysfunctionalities in this policy particularly in the enormous and quite unnecessary burden it places on the balance of payments, and in the additional constraints it creates against improvement and change in the state sector. It would be damaging to indigenous power equipment manufacturers, particularly the BHEL, just when it is showing the potential to be an important international player in the industry.

Moreover the policy is fundamentally flawed in not recognising that bulk purchase of power by a utility, necessarily acts against the interest of the utility (except in the case where the utility's cost of power generation from its new 'marginal' unit is higher than for an independent power producer). If the policy is amended to avoid a bias in favour of the IPPs, little of the planned investments, especially from the foreign sector (or from projects that are not linked substantially to captive demand), would materialise. That there are significant social gains in having power generation (and not just distribution) in large integrated firms, has been little appreciated.

The vicious circle that exists today can be broken only if the government gives up its monetarist blinkers and realises that investments can in part 'create' savings, especially in a sector like power where the marginal product of power is far more than the cost of generation. Large

under-utilised capacities in the equipment sector further add to the savings potential. Dysfunctional environmental "movements" that have unnecessarily delayed and foreclosed the options for cheap and reliable hydel power can hardly be wished away. The indulgence of competitive populism of subsidised power to households and the agricultural sector, which only helps the middle-classes, can be broken by linking central contributions to the SEBs to their efficiency, and to the resources they are able to generate.

Introduction

In Section I of this paper we examine the financing implications of the DPP, and then show that the high cost and large outflows of foreign exchange in the medium term are features common to all IPPs with substantial foreign stakes; and that this is inevitable when the foreign majority route is adopted. In Section II we argue that there is a fundamental pricing problem in bulk purchase of power from the IPPs unless tariffs based on time of the day and the season can be arrived at. In Sections III to V we examine the well known problems of the SEBs, but in an integrated fashion and show that there are vast differences in the operational efficiencies and effectiveness of the SEBs, so that a blanket condemnation of the state sector is uncalled for, and may have only served to create an environment favourable for foreign participation. The neglect of industrial demand resulting in the rise of captive generation, and the inverted tariff structure are problems common to all SEBs. In Section VI we examine one of the antecedents of the crisis - the woeful project implementation particularly of hydel projects - to which the increasingly articulate and dysfunctional environmental movements, problems in interstate agreements, and inadequate funding have all contributed. Sections VII and VIII examine the PLF and cost of capacity of the NTPC, bringing out the economic and technical basis for a national alternative. In Section IX we pose the national alternative, and show that its pursuit would rid the BOP of an enormous burden, that would otherwise arise. The savings constraint argument as a basis for foreign financing and management of power projects is shown to have only limited validity. In Section X, some of the key choices for bringing about a healthy power sector are highlighted.

Section I: Finances of the Dabhol Power Project

The DPP has a capital cost of Rs. 3209 crs. for the first phase of the project, and the items of capital cost have been discussed at some length in the press and elsewhere. See Table 1. Yet it needs to be emphasised that the preliminary expenses which are being capitalised is way above what has been usual for projects thus far in the country. Similarly, technical consultancy, is an item that arises largely because of foreign involvement. In comparison to NTPC's project with foreign equipment supply, but with part of the technical consultancy from within, it is higher though not out of line with the recent Gandhar Station. The latter was set up as a turnkey project by the consortia of ABB, ABB India, and Marubeni[1]. The Dabhol Power Corporation (DPC) has attempted to compare its Phase I project (without the jetty) with the Kawas Station of the NTPC, and Reliance Industries' Nagothane Power Project. The Kawas plant has a lower 1997 project cost[2] than the DPP despite the delay caused by the uncertainty regarding gas supplies, but the Gandhar Station's 1997 costs were high enough to be comparable to that of the DPP. The difference between the two may well be because the Kawas plant was subject to international competitive bidding (being in part financed by the World Bank), whereas the Gandhar station depended on bilateral credit. With bilateral credit there is always the tying of equipment, and overpricing. With the change in the site for the unit being set up by Reliance Industries, to Patalganga, the project cost is likely to be less than Rs 3 cr/MW. But this is not the central point. With many IPPs in the pipeline, one could always pick and chose the projects to be compared to show whatever one wants to, as regards cost.

Yet from the data of all projects for which the Memoranda of Understanding (MoUs) have been signed (many of these are undergoing significant revision since the

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[1]The Project was built on a turnkey basis, to avail of bilateral credit by a consortia consisting of ABB, ABB India, Marubeni, and Kawasaki Heavy Industries of Japan. The entire 635 MW was put on the grid on 4th April 1995. The station consists of 131 X 3 MW (GT) and 255 MW (ST); and the project cost was Rs. 2206 crs. The 131 X 3 (GT)'s were completed on 17th March 1994. Therefore the weighted average time of installation is Sept. 1994. Hence in early 1997, we may work out the per MW cost as $(2206/635)(1+0.1)^{2.5}$ which is Rs. 4.41 crs/MW, (at an assumed 10% rate of inflation).

[2]The Kawas Gas Project, being World Bank sponsored, was subject to international bidding. It was executed on a turnkey basis by M/S Alsthom of France. The contract was awarded in March 1990. Some of the details are as follows:

Original Project Estimate (c.1993)	: Rs. 373.98 crs.
Anticipated Project Cost (1991-92)	: Rs. 1153.96 crs.
Anticipated Project Cost (1993-94)	: Rs. 1488.72 crs.
Actual Cost as Anticipated (1994-95)	: Rs. 1494.51 crs.
Date of Government Approval	: Sept. 1986
Originally Scheduled Date of Completion	: April 1990
Anticipated Date of Completion (1991-92)	: March 1993
Anticipated Date of Completion (1993-94)	: March 1993
Actual Date of Commissioning (1993-94)	: Sept. 1993

(Although the units were ready, lack of gas supplies delayed the actual synchronisation of the units). The schedule of completion was as: GT-1 (106 MW), March 1992; GT-II (106 MW), May 1992; GT-III (106 MW), June 1992; GT-IV (106 MW), August 1992; ST-V (110.5 MW), Feb. 1993; ST-VI (110.5 MW), March 1992. The above information has been culled from various Annual Reports of the Ministry of Programme Implementation. We may therefore compute the capacity weighted average time of commissioning to be Sept. 1992. So that the cost/MW effective on Sept. 1992 is Rs. 2.32 crs. Hence the cost/MW effective in March 1997 at an assumed inflation rate of 10% is Rs. 3.56 crs/MW.

cancellation of the DPP),[3] it seems that DPP's is on the high side though not entirely out of line with the gas based projects (Table 3) or projects with significant foreign direct investment (Table 2). IPPs with FDI seem to have a significantly higher cost, so that the issue of high capital cost goes beyond the DPP. In Section VIII we would show that these costs are way above NTPC's existing cost of capacity as in early 1997. We know that in the case of NTPC's projects there is substantial unbundling ranging from management of operations (in case of foreign turnkey projects set up under bilateral credit) to entirely indigenous projects as when BHEL was the contractor, so that today we would argue that there is an inverse relationship between the project cost and the degree of foreign involvement[4]. This arises because of the Indian advantage of cheap skilled manpower. The 'interlocking of the markets' for technology and equipment, with the market for finance, that comes along with substantial foreign funding, adds to the cost of a packaged deal. The second half of the eighties have witnessed a world wide surge in FDI in services [UNCTC, 1988] and a substantial part of this increase has come from large manufacturing corporations. General Electric (GE), for instance have set up service affiliates like GE Finance whose principal task is to give GE products, in international markets, that added push via private finance, in addition to the usual credit from exim banks and bilateral sources.

In the DPP case, foreign majority equity participation has imposed its own additional costs coming from the risk premium that FDI attaches to investments in a third world country like India. In the DPP case the return to equity capital is not formally guaranteed at 16% in dollar terms (as is usual in other IPPs). Yet, the Power Purchase Agreement (PPA) of the DPC with the MSEB and other clauses in the project agreement virtually ensures that return on equity capital would be in the range of 28 to 30%, in dollar terms. This is because the indexation scheme in the PPA implies that all price fluctuations on operations (fuel, O&M costs) would be passed on to the MSEB via the tariff. The only way the DPC could earn less than 28% is if its project suffers from cost overruns and it cannot ensure an availability of 90%. The PPA allows a tariff of Rs. 2.75 if DPP is restricted to a plant load factor (PLF) of 68.5% and a tariff of Rs. 2.40 if the MSEB can offtake at the rate of 90% PLF. In other words MSEB would lose if it tries to

[3]Recently, the DPP itself has undergone revision, which is being touted as a reduction in the cost/MW. Much of the reduction is based on merging Phases I & II of the project, and using the gross ISO capacity which includes peaking capacity, than just the base capacity alone as earlier in the computation of the cost/MW. Change in fuel use and separating out certain supportive investments have also brought down the reported figure. Fall in turbine prices internationally has also contributed. But the details of the new agreement are not yet known clearly. No doubt the state government was able to get some real reduction in both the tariff and the cost, because the Enron Corporation had already committed resources.

[4]The National Working Group on Power had pointed out that projects built using (tied) bilateral credit are often 40% more expensive than indigenously built power plants! [CMIE, July, 1995 p. 25].

restrict DPC to a load of less than 90%. Given the terms of financing of the debt and their repayment schedules, we have calculated (as in Table 4) the net foreign exchange inflows. During the construction phase there is a net inflow of $718.9 million. The net outflow in the second year (1st year after commencement) is $95.5 million and ranges from $74.5 million to $170.1 million during the 30-year period. In the 31st year there is a net outflow of $266.2 million[5] on account of the retirement of the foreign equity. This stream of cash flows entail an IRR of 18%. This is way above the rate at which India can easily borrow to set up a power plant physically the same as the DPP. It is about 7% above the return available to power projects in the US. The facts above are hardly surprising to anyone reasonably familiar with the FDI phenomenon. Payback periods of two years or less are very common in transnational direct investments in the third world. *In power, unlike in other'high-tech' areas, or patented or brand name protected products and processes, TNCs have no obvious advantage. In power it is difficult for them to realise high returns on equity in fair competition with each other and with local firms as in the Indian case. Nor is there any expectation of major technological changes that reduce cost, creating the potential for private enterprise to make high profits, by appropriating (via internalisation) in part the benefits of technological advancement. The only advantage is their access to surplus capital from advanced country sources. So only through a policy that specifically raises their return on equity to levels comparable to earnings on FDI in the third world generally, can they be expected to make investments on a large scale.*

Section II: Utilities and IPPs

In this section we explore at some length the implications of a large utility choosing to buy power, rather than set up its own marginal unit in a situation of demand growth. A utility would in general have generating plants of various vintages and capacities, each with its own fixed costs and unit variable costs. For each unit, the unit variable cost could in a small way vary with the levels of output, but we choose to ignore this detail. For simplicity let us consider just three plants *A*, *B* & *C*, all being thermal units whose cost of capacity at original book values (purchase price) are all assumed to be the same. This is done only to focus on the unit variable costs (V) for the three plants, which are assumed to such that $V_A > V_B > V_C$. *A* would normally be the oldest plant, and *C* the youngest. At depreciated values the fixed cost of plant *A* may be very low or zero if it is sufficiently old (older than its standard life).

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[5]One could differ in the treatment of equity. One of the reasons for the enhancement of the government with foreign direct capital, besides availability, is that multilateral lending institutions do not include equity in the external debt. The appropriateness of this practice in case of large infrastructural projects with little or no generation of foreign exchange is debatable. Herein, even if equity is not retired, the IRR is hardly affected.

Clearly, independently of the fixed costs, the utility would chose to operate plant *C* more than *B*, and *B* more than *A*. So that if we abstract from costs of cold/hot start, etc, the 'on-cycle' would be ***C-B-A*** and the 'off-cycle' ***A-B-C*** as long as base demand (lowest level of demand) is greater than or equal to the output capacity of *C*. In other words, *C* would tend to show the highest PLF and *A* the lowest. Thus the utility's switching cycle is also socially optimal. If now the utility considers hiving off *A*, as an independent commercial undertaking, it would have to buy the capacity and power separately from the independent entity (IE) in order that the socially optimal switching cycle is retained. Buying only power would mean that plant *A* is operated most; which while it may suit the IE would not the utility, and it would not also be socially optimal.

On the other hand if the latest vintage plant of type *C* is sought to be set up as an IE, then the utility would have to buy ***power and not capacity***, and push the IE to highest possible PLF for costing of power. The utility would find the arrangement acceptable only if IE's costs of generation are lower than the utility's. This can arise on account of lower project cost of IE or the IE's ability to achieve higher PLF than the utility. The lacuna in the deal of DPC with the Maharashtra State Electricity Board (MSEB) was that DPP's power was based on a PLF of 68.5%, which is too low. The entire MSEB thermal system had been averaging a PLF of about 60% over the last several years; and many of its *C* type plants in excess of 70%. To compare DPP with the MSEB as a whole is wrong; what is relevant is the PLF that MSEB has been achieving on its new plants, which is significantly above 68.5%. This means that the DPC-MSEB agreement would not be acceptable if MSEB was allowed to have a commercial orientation[6]. Then the scope for IPPs is quite limited, and it narrows further as utilities are able to achieve high PLF on their new (base) units. Given a situation of continuing growth in demand for the foreseeable future, the option for the utility to add capacity is real. So an IPP becomes acceptable only if (a) the utility can gain (or not lose) by buying power from an IPP, rather than producing the same itself, and (b) the IPP can earn an adequate return on its investment. In today's context, the cost of power from an additional fresh unit which the better performing SEBs like those of AP, Maharashtra, Rajasthan, Tamilnadu, is not higher than buying the same from IPPs. Thus a fair deal on the considerations above is not possible. Yet, why are SEBs tying up for IPPs with the private sector? Quite obviously, because the playing field is not level: utilities continue to be under pressure to subsidise power, have little budgetary support and have to cater to increasing demand.

[6] And certainly so given the reform agenda, since a primary objective of economic reform is to bring about efficiency and commercial orientation in all productive entities.

Section III: Corruption, and the Management Problem

The average PLF of the SEBs' thermal plants has been rising though it is far from being satisfactory. It had reached an all time low of 44% in 1979. With the pick up industrial growth and some improvement on the labour relations front in the eighties it rose during the eighties and nineties. See Fig 1. Despite this hopeful sign, a more disaggregated picture reveals that the problem of severely low PLF particularly in the Eastern Region continues to remain despite the reform process having started four years ago. The continuation of such bastions of inefficiency and dysfunctional orientation is observed in many sectors.[7]

Bihar and Orissa, with the richest resources for thermal power and heavy and basic industries, show PLFs' of 20 to 35% against a national average of 55%, and a (simple) average of 67.1% for the Southern and Western states, in 1994-95. See Table 5. Clearly, therefore, ***the SEBs do not constitute a homogeneous set***. Bihar and Orissa as also Delhi, West Bengal[8], Assam and Haryana have shown little improvement. AP and Rajasthan with PLFs in excess of 68% may be recognised as having achieved reasonably efficient generation, and if the trends continue, Maharashtra, Tamilnadu (and possibly MP) may follow them in the next couple of years. Punjab with large hydel capacities and the opportunity to draw from the Bhakra Beas Management Board, is expected to have lower PLF for its thermal plants in years of good monsoon unless large scale interstate sale and purchase of power is institutionalised in the near future. Gujarat, Haryana, Karnataka and UP could perhaps overcome their generation problems without major change in their operational practises.

Transmission and distribution losses range from 43% (J&K) to just about 16.3% (Maharashtra). A T&D loss of between 10 and 14% is about all that is admissible. The rest is either due to poor grid management, improper and poorly maintained transformers, high power factor in the system, and above all theft, largely by the small

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[7]We would contend that the reform process has succeeded, largely in liberalising trade and external investment, only because these were easy to bring about. The so called 'water in the tariff' was removed without substantially hurting industry. Delicensing was by far the most important success which has allowed a freer ground for private entrepreneurialy oriented business. Yet delicensing without an exit policy has loaded the system with 'non working' or poorly performing enterprises, especially public, which continue to be a sink for resources. Similarly, subsidies, particularly those that benefit the middle classes, have hardly been affected; and public sector workers have strongly and effectively opposed privatisation. Infrastructural areas (ports, railways, road transport) continue to be under the quagmire as before; and dysfunctional union behaviour is still unchecked in bank, airlines, steel, and coal.

[8] West Bengal shows a sharp improvement (57%) in 1994-95, from 40.7% in 1993-94, and if this is the beginning of a real change, which may well be, given the change that the CPM govt. is trying to bring about, from the dysfunctional orientation of its past.

scale sector[9]. The South and Maharashtra have had distinctly lower T&D losses, while, the North had the highest. The differentiation in this case is not so clear cut as in the case of PLF. Thus without much hesitation, we can say that the East is yet to get even its production right, whereas most states including those that have been having reasonably efficient production, (with the exception of Andhra, Tamilnadu and Maharashtra) are subject to pressures to condone theft.

One knows that, the pressure to accommodate vested external interests (especially at the state level) is very large. Such vested interests could very well operate through their power over state enterprise, while top and middle level management are powerless to change or may even be actively collaborating with such interests. Yet this kind of corruption is different from the powerlessness and lack of control of managers over the enterprise resulting in low productivity. Corruption results in an illegitimate redistribution while the lack of control means a real cost to the economy, because resources are under/poorly utilised. While the former affects most states in varying degrees with the (possible) exceptions of Maharashtra, Punjab, Andhra Pradesh and Tamilnadu, the latter is a phenomenon that cripples the entire eastern region - Bihar, Orissa, West Bengal, Assam, the Northeast, and possibly Delhi and Haryana. It arises mainly on account of lack of control down the line in the productive enterprise, fostered by a kind of aggressive, dysfunctional employee behaviour that is not limited to workers alone.

The large outstandings of the SEBs to the Central power corporations (NTPC, NHPC, NEEPC, Rural Electrification Corporation), has been a matter of much concern, but little improvement has taken place. See Table 6. In understanding this process it is important to note that the central corporations' (NTPC and NHPC) capacities have largely served the Eastern and the Northern regions, rather than the Western and Southern. Capacity creation in these regions may have helped to cover up the deficient performance of the SEBs in the East and North.

The better performance of the South and the East has not only gone unrewarded, but the centre's policy has discriminated against these regions, especially the South. When the addition to capacity by the Centre, during the Eighth Plan up to March 1995, was at a rate of 3.21% in the Southern Region, in the Eastern Region, it was 20.49%! See Table 7. Firstly, notice that the central share is highest in the Eastern region followed by the Northern Region, the region that had the PLF of their SEBs system at 31.6% and

[9] Admitted by certain concerned managers of SEBs; As claimed by a former Chairman of the CEA, not only a large part of T&D losses but also a significant part of the power reported as being supplied to the agricultural sector may indeed be stolen by other small industrial users with the connivance of the SEB staff.

57.1% (excluding Rajasthan 52.6%). The North-East (a special region in many ways) too had a higher than average central share. The Southern, and Western regions with high PLFs, have had the lowest shares.

The deficits in terms of peak shortfall and energy shortfall (average of 1991-92 to 1994-95) are high for the North Eastern, Southern and Eastern states. Yet the entire shortfall can be covered, leaving a surplus, in both the North Eastern and Eastern region if the PLF of the SEBs' thermal stations were to go up. We may compute the additional generation (if the thermal stations of SEBs were to reach an average PLF of 65%) as a proportion of total (including central generation) in the regions. We see that ***in all regions except the South the energy deficit can be wiped out***. In the South the need for additional capacity creation is most urgent and the centre's creation of capacity has been at the lowest rate of 3.21% in the Eighth Plan (till March 1995) as we had already mentioned. Addition to capacity would nevertheless be required in the Northern and Western Regions too to cater to peak demand, whereas in the Eastern and North-Eastern regions a large part of even the peak demand can be met by achieving good PLFs.

It is not the case that the state SEBs of the South and West have added capacities at a lower rate. There is a rough equality in the capacity addition rate by SEB systems across the regions; with both the North and South showing marginally lower rates. Central funding being linked to factors other than performance, means that growth in budgetary provision is roughly proportional, so that not much variation in the rate of addition to capacities is observed. Obviously, it is in the interest of state governments to use such funds. On the other hand the regions differ sharply in terms of their performance (both project implementation and operations) as we said earlier. And the key to poor performance is the degree of control within the SEBs as organisations. The inability and the unwillingness to break the nexus of politician-bureaucrat, and employees, who run SEBs for their own gain, get reinforced so long as these organisations have access to funds. Herein the 'soft-budget constraint' of Janos Kornai [1986], may provide part of the explanation. Ultimately the pattern of the centre's allocation for the power sector, is responsible; which as we will argue later ought to be determined in a way that punishes poor performance and rewards better performance if the SEB system has to improve. No doubt there are political difficulties here but, then the reform processes can hardly afford to shy away from vested interests.

A possible economic factor in the regional pattern of NTPC investments is no doubt the abundant coal resources of the Eastern region; but then the interstate and inter-regional transport of power is very small, beyond the fairly large transport of power within the NTPC system, which is still intra-regional. While the best coal may be found in the Eastern region, other regions (in contrast to states) are not denied of this resource - Singareni in AP, Central and Western Coalfields; lignite deposits in Tamilnadu and Rajasthan etc. The pattern of investments could also arise from the fact that better performing SEB's in the South and West would not have the same incentive to buy power from the NTPC, as the poorly performing ones. This arises from the nature of NTPCs pricing of bulk power.

We now go on to pattern of dues of SEBs to the Central Power Corporations (CPCs), which is quite revealing. The NTPC-NHPC hand that has served the errant SEBs of the Eastern, and Northern sectors is being bitten by the very same SEBs. Their dues to these corporations constitute the bulk of the dues from SEBs, with hardly any outstandings from the South and the West. See Table 6. State wise purchases of electricity from the central corporations was not available, so in the first instance when we compute the ratio of dues to total electricity sales by utilities, we find that the dues in paise per KWH for sales is high as 193.5 for Jammu & Kashmir to as low as 0.2 for Goa. States like J&K and Bihar would not have paid the CPCs for more than a year! Obviously, these states have the political muscle to get away without paying, which in part allows them to continue with their corruption and poor managerial control.

One may raise objection to the figures in Table 6, because the dues are computed on turnover, rather than on purchases from CPCs. State wise data on purchases from CPCs are not readily available, so we have instead estimated the central generation regionwise and assumed these to have been purchased by SEBs in the region[10], a regional picture of dues to CPCs can be constructed as in Table 8. It reveals that on every KWH of electricity purchased in a year the outstandings for both the North and the East are in excess of 50 paise, and about 12 paise or less for all the other regions! Thus the Northern and Eastern states have been paying barely twice a year.

Section IV: The Neglect of Industrial Demand

From Fig 2 it is apparent that since 1978, non-utilities (which consist largely of capacities for captive generation by industry) has grown faster than utility power capacities. Indeed, today captive power generation is a must for any successful power intensive industry. There are several factors in the emergence of this phenomenon.

The seventies showed growing power use in agriculture as the green revolution and the use of the HYV seeds, which required controlled irrigation, spread. The growth

[10] Cross regional sales, or ad hoc sales are too small to be taken into account.

rate of demand from a low base, was rapid for the agricultural sector since 1964 when the HYV program was launched. See Fig. 3. Investments in major irrigation declined, due primarily to a funds constraint which was in a large measure caused by the unbelievably low pricing of water, poor management, and above all increasing time overruns in projects. All these pushed the flow of benefits beyond the political cycle of five years, so that the political appropriability of the benefits were quite uncertain. Today, except possibly in the case of the Narmada Project, the interest of the politician and the bureaucracy in large irrigation projects, rests largely in the scope it offers for graft (of about 10% on all contracts), and patronage.

In contrast, minor irrigation was less onerous (despite it very high social cost) on the state to administer; it had to bear only a part of the costs of development - surveys and studies, digging proving wells, etc - the major cost being borne by the private sector. The differentiation of the peasantry was accelerated by the "green revolution" being pushed through without a prior institutional change in tenurial relations. This biased the "green revolution" in favour of investments that could be privately controlled and managed, even if the same were not socially optimal. Thus, tanks (whose marginal costs for water supply are small) fell into disuse in South India, many canal systems were misused in UP, Maharashtra, Bihar and elsewhere, even as ground water exploitation greatly increased. Rising oil prices, despite the slower rise in diesel prices, meant that the demand for electricity for pumping water grew very rapidly; and since the middle and rich peasant is an increasingly powerful force in national politics, the game of competitive populism to supply electricity at very low prices to the agricultural sector proved irresistible. Heavily underpriced electricity has no doubt lead to increased demand, even from scattered farmers who could have optimally used diesel, leading to longer distribution lines, and system losses. When industrial growth picked up in the eighties, the SEBs were caught napping. Only the SEBs of the South (excluding Kerala), and Rajasthan, were able to respond in some measure with increases in PLF, and better distribution. But the industrial demand in the face of stupendous growth in the agricultural sector and high growth elsewhere could not be accommodated.

The trend towards captive generation accelerated, as SEBs one after another in domino fashion, raised the tariffs on the bulk consumer, above those charged to other more expensive consumers - households, commercial and agricultural sectors, and far above production costs. *Indeed by the nineties the pricing of power to the industrial consumer (at Rs. 1.40 to 2.10 per KWH), was such that industry even by installing expensive diesel generation could generate power at a comparable or lower cost than SEBs' prices.* Moreover, the uncertainty in the supply of power could hardly have been tolerated by process industries like cement, chemicals, petrochemicals, paper, metallurgical etc., since in such industries the cost of erratic supply is too high in terms of material wastage. Other units with a more flexible dependence have also gone in for captive generation, to avoid the poor quality of power (due to erratic supply, frequency and voltage variations) from the SEBs, and to have better control over the production processes. The risk of bulk industrial users in depending upon the SEB system even in a state like Gujarat (with its industrial orientation) is amply demonstrated by the recent episode brought about by the poor monsoon in that State. To save standing kharif crops, the Government had to go in for ad hoc power cuts to industry. Today, in industrial concentrations, like the Thane-Bhelapur belt in Maharashtra, there is a great dependence upon self generation. In Bihar, Orissa, and till recently West Bengal, with amateurish SEBs, utility supplies are at best auxiliary to self generation for large industrial users. Co-generation in industries that have the potential - particularly sugar, steel, certain chemical processes - is growing very rapidly.

While a certain amount of captive generation, particularly when there is scope for cogeneration, is socially beneficial, captive generation by bulk users is bad for the SEB system or for most utilities, unless there are institutional and price mechanisms (based on the hour of the day and season) for wheeling and dealing. The cost of supply to bulk users, particularly process industries with round the clock demand is low, not only on account of lower distribution costs, but also because the demand can be met by base level units, which can operate at high and steady PLF, realising scale economies, lower use of oil, and lower auxiliary (self) consumption of power. As more and more units get out of the utility system, the utilities have to bear a higher variability (diurnal and seasonal), than other wise, which the SEBs are hardly equipped to[11]. Socially, captive generation, except by plants with a capacity around 100 MW or more, are hardly optimal. They have higher unit variable cost of generation (sometimes over twice that of 500 MW units, and thrice that of large pithead generating stations). Their capital cost per MW tend to be the same or higher. Below 30 MW the capital costs are much higher.

The aggregate capacity of captive power plants by 1993-94 had reached a level of over 11% of all installed utility capacities, and was in excess of 17% of thermal utility capacities. The principal problem has been the SEBs' inability to keep the bulk consumer, as demands on its capacity from the agriculture and other politically sensitive sectors had to be accommodated. The figure of 17% for non-utilities in thermal capacity hides more

[11]Much of the SEBs capacities is in coal based steam generation plants, which have longer switching times, and the hydel-thermal ratio has been falling rapidly. Gas capacities though they are growing rapidly, constitute only a small part of the total thermal capacity. Gas is only a second best option, to a mixture of thermal and hydel. It is only the woeful failure on the hydel front, that makes the high (variable) cost option of gas attractive.

than what it reveals. Over the eighties, the share of industrial demand (as revealed by the final sales figures[12] had been coming down, so that if we look at the extent of captive generation from the view point of the consuming industry, we find that the ratio of captive generation to HT sales, ranged from a low of 23.2% in Punjab to as high as 232.2%[13] in Orissa! See Table 9. Captive generation as a proportion of the total metered purchases by industrial units, ranged between 23 and 186%. In the East, North-East and North, captive generation is more pronounced. This is no doubt due to the failure of the SEB systems in these areas as discussed earlier. But even at 23% for Maharashtra, and 41% for AP, the dependence of the organised industry on captive generation is large. In relation to certain fast growing (and often energy rich) LDCs like Nigeria, Indonesia, it is not high, so we may be tempted to take the position that the SEB policies and practices which have pushed industry to higher use of captive generation can be condoned. But for a large and diversified economy like ours which at the same time has been following a policy of high prices for energy, captive generation increases the capital output ratio for industry and to the extent that it is more capital intensive than utility based generation, it also raises the economy wide capital output ratio. The ratio of captive to utility generation (at 20.80%) was way above the ratio of installed capacities by "autoproducers" to utilities for Europe, North America, and the Pacific OECD countries, at 9.25, 0.78 and 9.07% respectively. This means that the utilities in these regions have been able to retain their bulk consumers. Germany had the highest share for "autoproducers" at 16.03, followed by Finland (15.56%) and Italy (15.10%)[14]. See Table 10.

We do observe that the PLF of thermal plants is inversely correlated (coeff. 0.74, sign. 0.0026) to the ratio of captive generation to total generation, for a sample of 14 states. Thus even at this crude level of dis-aggregation (and with many other factors influencing PLF) the vital demand stabilising effect of the bulk industrial consumer is possibly reflected. The causation could well run the other way in the states of the East with very low PLF for their thermal stations.

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[12]This does not necessarily mean that the industrial demand for electricity has been as slow as it has been made out to be. Not only was captive generation growth rapid, but the increasing T&D losses, as also part of the supply to the agricultural sector particularly in the East, as we shall see, may be ultimately going to the industrial sector particularly the small industries sector.

[13]In Orissa, NALCOs captive generation plant managed by the NTPC has been generating more power than the SEBs sales in total. Orissa has recently privatised, even the distribution. This may be the best option since in a state with little household demand, and with an unbelievably corrupt and inefficient Board, privatisation can set right production.

[14]In these economies, which are past the stage where their competitiveness is based on costs, the cost of electricity is less important than its availability on demand. High quality supply means catering to a highly variable diurnal and seasonal demand (because a very large part of electricity sales is to households), for which reason low PLFs and high costs (and prices) are justified.

Section V: Inverted Tariff Structures

Using prices for the domestic sector[15] as the reference, the prices for the agricultural sector range from nil to about 83% in Delhi. See Table 11. On an average (simple over the SEBs) it was only 48% of domestic prices. In the Western SEBs it was 39% of domestic prices. In the South, in Tamilnadu and Karnataka, there was no tariff as such for the sector, being based on a flat rate per pump set, irrespective of consumption, and around 20% in AP and Tamilnadu. In the East and North East it was somewhat higher, than elsewhere. *For medium and large industrial consumers it was in excess of 1.5 and generally 2.5 times the prices to the domestic sector.* In UP and Delhi it was 6.4 and 4.4 times the domestic tariff. For price discriminating monopolies, with no unsatisfied demand, the price for the domestic consumers should be the highest, and for large industrial consumers the least, since the elasticity of demand for households is low, while that of industrial users high (except in the short term). For the agricultural sector also it is likely to be larger than for the household sector and here the distribution costs are likely to be more than for the industrial consumer. In most OECD countries the prices for the household sector is twice that for industrial and commercial users. Clearly therefore, the SEBs are not price discriminating monopolies. That the pricing is exactly the opposite of what it "should" have been forcefully underlines the role of politics (and "social" considerations) in its determination. Yet, coupled with the pricing, if we realise that the rural electrification programme, and such schemes as the "Kutir Jyoti", have greatly increased the proportion of population that has access to electricity, then clearly there does seem to have been more than an accommodation of vested interests in the Government's policy. The Governments' concern to make available electricity to all seems sincere enough and one can hardly criticise it for this objective. But low prices may not be the solution at all. There is enough indication that for basic lighting and fans, even poor people have the ability to pay for units consumed, because even at say Rs. 4/KWH electricity it is cheaper than kerosene or oil lamps. High prices for electricity with the state bearing the cost of electrification is a better way of achieving its objective: The current low prices of electricity for the household sector only leads to its wastage and excessive use by all except such of the poor who have been fortunate to have had access[16]. While differential pricing to the household sector based on the number of units consumed per meter is a possibility, it is ruled out on practical grounds in the present context. So a feasible solution to the problem of increasing access, and yet limiting

[15] Domestic sector prices in very many SEBs particularly in the North are below unit costs.

[16] Electricity consumption by households at low levels is need serving especially when used for lighting and fans. At high levels, as when it is used for airconditioners and water heating it is indeed a luxury. Electricity unlike clothes (which is similar to it in the sense of being both a luxury and necessity) can hardly be differentiated being the purest commodity in this sense.

wasteful/ excessive consumption may well be to price electricity at high rates to all households. The rates would have to be sufficiently high to cover not only costs but leave a surplus for increased capacity creation, because still as much as 40% of the population do not have access to electricity![17]

Electricity prices to a productive sector like agriculture poses little conceptual problems. Since peasant farms, even non-surplus farmers deal through the market, increases in input prices can easily be passed on to the consumer in general via the market, given a certain level of inflation. That such terms of trade increases could adversely affect the poor is hardly a critique that can be made against the commercial pricing of electricity since when examined it really implies (quite wrongly) that poverty can be overcome via a unsustainable subsidisation.[18] Such pricing is no doubt a hangover of the era of the so-called 'hindu-growth period' of low (around 3.5%) growth (1965-1979), during which the politics of the country shifted sharply to issues of redistribution.[19]

We had already mentioned the claim that part of the supplies, reported as being made to the agricultural sector may indeed be theft by others -industrial and commercial units in urban areas, to square up the revenues with the system supplies! This practice according to the same source is quite widespread, and our own discussions with officials seemed to confirm it. This is theft over and above the theft that go with high T&D losses. We ought to find some correlation between T&D losses and energy (reportedly) used per

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[17]In any populist pricing of infrastructural services (railways, road transport, telecom, irrigation water, electricity), low prices hurt the target group more than it helps, since supply constraints (at least in market economies subject to budgetary constraints as the Indian certainly is), mean that even as the price is low many from the target group remain "outsiders" and so is anti-poor. If in having access, the benefit to the "insider" is large it is only fair that the "insider" does not stand in the way of the expansion of the service.

[18]Historically, in late industrialising countries with dense populations, it is only land reform that in enhancing agricultural output (from the poor farmer) has created the conditions (primarily demand) for enhanced industrial growth, which alone has been capable of greatly reducing if not eliminating poverty. Consider the following countries: China, South Korea, Vietnam, Japan, Thailand and Taiwan. The strong state, the efficient bureaucracy, outward orientation, the efficient shopfloor, investments in health and education are only parts of the story of the industrialisation of these economies. *What is indisputably common to all of them is their enhanced agricultural output during their transformation phase, which followed from a one shot redistribution of land, and to a strengthening of the institution of private property. In contrast countries like India with a prolonged and continued subsidy based redistribution (a la IRDP, food subsidy etc) do not show the "high speed" growth that may well be a characteristic of successful industrial transformation in the late twentieth century.*

[19]This was the period in which so many sop programmes, such as the IRDP, were introduced and the rhetoric of poverty alleviation, became very shrill. The MRTP Act, the Bank Nationalisation and the abolition of pricing pressures served to heighten the rhetoric, and internalise the political gain. Such measures may be fruitfully seen as the holding out operations of a besieged state that was clearly putting its survival ahead of growth and transformation, which alone can eliminate poverty. That the left and many other critics harp back to this period is indeed strange, but perhaps not, if we recognise that this was a very important period in the formation of the new intelligentsia.

pumpset. From Table 12 it is evident that there is much variation in the energy consumed per energised pumpset from about 924 KWH in Kerala (rather special, since many of the pumpsets even in rural areas are for household well water supply) to about 81,713 KWH in the case of J&K! The latter is way above the figure for large agricultural states like AP, Maharashtra, TN and UP. State wise data on T&D losses is highly correlated with the reported KWH/energised pumpset (coefficient: 0.75 or significance level 0.0003), so that we may infer that at the root of high T&D losses, high apparent usage per pumpset, (and also non-payment to the Central Corporations) is the same culture of irresponsibility, and graft.

Section VI: The Decline in Hydel Capacities

Hydel capacities which had increased rapidly up to the mid-sixties, during the Mahalanobis period, grew more slowly during the 'hindu growth' period, and thereafter, in the eighties and the nineties, has virtually collapsed. These time trends are also mirrored in capacity creation in major and medium irrigation. As a result the hydel-thermal ratio fell sharply from a healthy 40-45% to about 23% and is destined to reach even lower levels if the present trends continue. Large hydel plants are not only cheaper in terms of unit costs of power, but also have the potential to improve the PLF and operational efficiency of thermal plants of the same system, arising out of supply side synergies. Low switching times for hydel stations implies that it is possible to shift the variability (both diurnal and seasonal) on them, particularly in the immediate post monsoon periods when the reservoirs are full, and are available for net drawals. During times of heavy rainfall, hydel capacities can be fully utilised, since otherwise the waters would go waste if the reservoirs are already full or are anticipated to be full. States with high hydel capacities also show higher PLF for their thermal units, providing some, if weak, evidence for the positive synergistic effect of hydel capacity. (The correlation coefficient between PLF of thermal units and the state's overall hydel-thermal ratio is 0.30 at a significance of 0.25, for 1994-95 across 14 states). The cost of power for SEBs can in a large way be explained by PLF (the reasons for which are obvious) and the hydel-thermal ratio. See Table 13 for the regression results.

Yet, why have investments in hydel capacities plummeted? The answer lies in certain weaknesses of the Indian state: its inability to concentrate resources for economic benefit, and its growing tendency to accommodate various sectarian interests. These result in spreading thin the resources it can marshall, to the great detriment of long gestation period projects. Today, it has become fashionable to criticise large hydel and irrigation projects for their alleged high cost and adverse environmental effects. Firstly, even with all the loadings of the inefficient and corrupt bureaucracy, and the cost of delay, they are still cheaper than small projects. Secondly, a standpoint that accepts the actual costs (which incorporate the cost of delays -in a large part due to the lack of firm commitment of resources, and to the very process of criticism), as the basis for evaluation of costs and benefits - is entirely wrong. Standard costs (which are not the original estimates but the same blown up for inflation, and for the underestimation inherent in government projects) ought to be the basis for the strategic choicer between large versus small hydel projects, or between hydel thermal and gas. Other loadings due to inefficiency of implementation, graft and spreading thin are problems that need to be overcome. Incorporating them into assessment amounts to condoning the dysfunctional behaviour of the state and its bureaucracy, and foreclosing the exploitation particular resources.

Hydel power (and major irrigation and railway) projects, more than others in the public sector, are particularly prone to cost overruns, due to the larger gestation time. The delays and cost overruns [Morris, 1990] arise primarily because of the practice of spreading thin the state's resources, to accommodate more projects than it can bear[20]. Over-concentration on a few projects with compression of construction times can have large benefits[21]. The second (and this may have become the most important one today) reason for delays and cost overruns arise due to the process of environmental clearance. The major factors in delay for public sector power projects as reported by the Ministry of Programme Implementation [various issues] are: funds constraint, environmental clearance from the Ministry of Environment and Forests, land acquisition for compensatory afforestation, and other government clearances- largely slowness of the interstate agreements mechanism. See Table 14. Delay in civil works is also related to the funds constraint and to environmental problems. The data are not separately tabulated for hydel projects, but in these cases the environmental and funds constraint were even more important. They affected nearly all schemes except possibly the Salal and Dulhasti projects in J&K[22].

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[20]The very practice reduces the ability of the state to raise resources. The capital X time tie up factor due to delays and cost overruns has been of the order of 200% [Morris, 1990].

[21]In China "high-speed" growth is in no small measure due to the ability of the state and its parastatals to concentrate resources for infrastructural activities (including township construction, so obviously visible in Shanghai or Beijing today). with compression in the construction period. Micro-efficiency, in contrast, in many Chinese enterprises remains problematic even today.

[22]The Salal Project was commissioned on time, while the Dulhasti Project still reels with the problem created by the militants in J&K who kidnapped one of the French engineers working at the site. The French construction consortia was unable to work on the difficult terrain, and the heavy boring machines were ineffectual in the tunnelling work. The French may have used the opportunity provided by the militants to wriggle out of the contract, and justify the enormous time and cost overruns. In contrast the Salal Project which was indigenously executed under the leadership of BHEL had no problems.

The problem of environmental clearance needs some discussion. With Mr. T.N. Seshan as Secretary of the Ministry of Environment and Forests in the late eighties, a pattern of response to investment projects had emerged. Seshan's directions resulted in long delays for the clearance of projects, which in the case of certain hydel and transmission and coal projects, was as high as seven years! Seshan who was unwilling to see shades of grey, insisted on clearance being sanctioned to public sector projects only if for the lands affected, alternative land was made available to the Forest Department. So formal protection of forests (in other words any land under the control of the Forest Department was automatically treated as being protected), rather than a real solution to the problem was insisted upon. Despite these delays there is no let up to the degradation of forests in India, since the cause of such degradation is very much due to the corrupt and unscientific working of the Forest Department itself. This meant that (dysfunctional) environmental clearance became the biggest hurdle in public sector project implementation. Many a public sector project had to waste long years in acquiring land to compensate for the use of "forest" land, even if the so called forest land had long ago been degraded, and was even perhaps being cultivated! The rules for clearance established then, continue with the same vigour today, even after Mr. Seshan left the Ministry[23].

Hydel power and irrigation projects face a new threat today: "Public" interest litigation and agitations by self appointed protectors of the environment in India. The environmental movement in India has often taken an emotional and anti-industrialisation content. As it steadily gains ground it has become increasingly difficult for the soft state that we have to take up and push through hydel projects with large social benefits. The abhorrent behaviour of the Narmada Bachao Movement,[24] egged on by sections of the Western and Indian intelligentsia, has gone beyond its original justifiable agenda (to ensure a fair rehabilitation for the displaced, to a virtual dissent of development. As a result the damage to the Narmada project, which was being implemented in a fairly proper manner[25] has been large, and the costs and delays are bound to go up. The Tehri

[23]Transmission projects of the NTPC (now the Power Grid Corporation), and the SEBs, for intra and inter-regional transport of power, with great potential to improve the system efficiency and bring down T&D losses are being held up for want of compensatory land for the small amounts of forest land that the TL towers need!

[24]For an expose of the activities of the Narmada Bachao Andolan (NBA), see the pamphlet brought out by Arch-Vahini, a voluntary group that has worked most to bring about the rehabilitation of the project affected people including tribals. [Arch-Vahini, 1992] The Arch-Vahini as also, others close to the field, and the State Government have also answered the queries raised by the Morse Commission's (set up by the World Bank) Report on the Narmada.

[25]The real issue in the Narmada Project, now since the dam affected have been adequately compensated and resettled, is that of graft and poor construction quality. The nexus of the contractor and the PWD was allowed to operate even in this case of a prestigious national project, which was under close scrutiny. The

Dam in UP has been stopped several times, and it is doubtful if it would come through at all. All the expert committees that examined the seismic question have confirmed the basic soundness of the design and the ample safety factor that has been built into the design. The environmentalists who spearhead such movements have successfully taken the debate to an emotional and ideological plane so that the rational counter arguments by the State and organisations such as the World Bank[26] have been quite ineffectual.[27] That such movements have had little popular support does not diminish the influence their leaders are able to wield. The weakness of the Indian state and a culture that sanctifies the agitational mode (no doubt a vestige of the long independence struggle from foreign rule), enhances their power. The slowness of Indian growth through a large part of the post independence era, has excluded many - particularly tribals. This lends to anti-development movements built on the few who have been entirely excluded thus far, a 'moral' authority that elected governments are not able to neutralise. The tragedy is that "high-speed growth" alone can include all in development.

In 1989-90 the Kerala Government identified the total exploitable hydro potential of the state to be 5120 MW including the then existing schemes of 1476.5 MW. See Table 15. As much as 1025 MW of the potential having the lowest costs had to be dropped due to the pressure of the environmental lobby[28]. A further 700 MW worth of schemes, again with low cost, were indefinitely postponed due to the difficulty of arriving at inter-state agreements on the use of water; and a further 426.5 MW worth of schemes were awaiting forest clearance and were unlikely to fructify even in the Eighth Plan! This left only 1231 MW of exploitable schemes with a higher cost/MW than those given up. Some of these schemes have since then been dropped due to the pressure from the environmental lobby. Thus: "*For the past ten years [the] state's earnest attempts to launch new hydro schemes did not find ready response from the Central [Govt.] for various reasons. In 1980*

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dam itself even before its complete filling has been showing damage. This is admitted by officials privately.

[26][World Bank mimeo Dec. 1990] put out by the Agriculture Operations Division, India Department, has effectively answered in a point by point, the major 'issues' raised by Vijay Paranjpe in his book " High Dams on the Narmada". This book has virtually become a bible for the international and national anti-large dam movement. It is a major exercise in disinformation. To a social scientist, the interesting (meta) question about much of the (dysfunctional) environmental movement, today, in India, is the triumph of the irrational: How does one (rationally) explain the political economy of such movements? Are they just a distorted reflection of the post-modernism of the West?

[27]Hirschman [1992] casts a steady light, in an attempt to grapple with the current anti-industrialisation bias, that is inherent in the position of so many activists working for the poor, and the environment.

[28]In Kerala, the Kerala Shastra Sahitya Parishad (KSSP) and other groups have strongly opposed the construction of large dams in the Western Ghats. Their influence has been built on their yeoman work to enhance literacy, to educate the poor and to take science to the masses. While the cancellation of the Silent Valley Project is justified because of the uniqueness of the flora and fauna, most of the other projects which have been cancelled or are held up, are not.

when the project works were gathering momentum, the 240 MW Silent Valley HEP was directed to be dropped from the ecological angle. The 95 MW Kuriarkutty-Karappara and the 240 MW Pallivasal Replacement Schemes were rejected on the environmental angle. Other major schemes - 120 MW Poringalkuthu Right Bank, 270 MW Pooyamkutty Stage II are also not favoured for taking up. Thus most of the cheapest hydro power projects are not likely to come up. The next choice is for resorting to small/mini/micro schemes which in the absence of storage reservoirs will only function as seasonal stations and for that reason the generation costs are now high (sic). Still, with the aim of utilising the water potential of the state to the maximum extent possible, schemes of total capacity 80 MW in the VIII Plan, and 295 MW in the IX Plan have been proposed. Not only the capital cost per KW installed capacity will be more, the operation and maintenance cost will also be much higher in the case of these schemes." [p.7-8, Govt. of Kerala, 1989].

The Government of Kerala is therefore forced into micro/mini/small hydel schemes, at much higher cost. The enchantment of the environmental lobby with these schemes, is entirely misplaced. Their environmental costs are also not likely to be any less than that of the larger schemes[29]. From Table 16 which lists the (micro/mini/small) projects expected to be commissioned over the period 1990-91 to 1998-90 we see that the projects would have a firm power of only 30% of installed capacity, which is much smaller than what is usual with larger storage based systems. Since 1989, there have been further delays. The firm power level for the units which are not associated with large existing projects (tail races), or are without any storage is substantially lower than the 30% indicated in the table. Moreover the associated cost of power collection and distribution from units as small as 3.68 MW on the average, is high, and adds to the problems of power despatch and load balancing. Recently, some of these projects have been offered to the private sector for construction on BOO basis. The reserve cost (the actual bids are likely to higher) for the 20 or so projects advertised is the range of Rs.4.5 crs./MW, much above the construction cost of medium/large hydel projects including interest capitalisation.

If the rest of the country is headed towards the situation today in Kerala outlined above, then clearly the vast hydro-electric potential that the country offers is likely to remain unexploited till such time as a more meaningful and rational environmental

[29]The only valid environmental reason on which a large project can be rejected is if it destroys an identified biosphere reserve, since in a region like Kerala the seismic risk is very low. Seismic risk is high only in the Himalayan Region, where special measures like use of rock filled dams with large base sizes are called for. The displacement of persons, provided the benefits justify the same, is a social cost only to the extent that there is a cost of resettlement which can be factored into the projects' costs.

debate can emerge, and new institutional mechanisms allow for the quick settlement of disputes among the states for the exploitation of water for energy (and irrigation).

With these constraints, the Kerala power situation has worsened, with massive power cuts, and very poor power quality - frequent interruptions, large voltage variations, low frequency, overloading of particular distribution lines. These problems would undoubtedly continue in the immediate future. The situation is lamentable, especially because Kerala was a power surplus state in the seventies, and has the potential to remain so, on the basis of its hydel potential alone. With high power consumption per capita by households, growth in commercial demand, and relatively slower growth in industrial demand, the peaking power requirement is high relative to the rest of the country, and comparable to that in the metropolitan areas. See Table 12. This means storage based hydel systems are a must, if the peak demand has to be met.[30]

Section VII: Plant Load Factors of 'Marginal' Costs of Utilities

We had argued earlier that, on grounds of social optimality, and the interest of the utility, an independent entity generating base power would have to be pushed to accepting a high PLF for costing, commensurate to what may be considered as an allowed return on capital employed. Since the data on unit wise PLF for the SEBs and other utilities is not readily available, we are constrained to use indirect data that would show that the PLF of the large and new base units by SEBs such those of AP, Rajasthan, Maharashtra, Tamilnadu are significantly higher than the present norm (68.5%) used for costing in the policy on IIPs.

Thus over the period 1985-86 to 1989-90 (a period of good rainfall which exerts downward pressure on the PLFs of the thermal stations), for the APSEB, we do notice that the main 210 MW units (of the Vijaywada Thermal Power Station, VTPS) used as base right through the year including the monsoon, the PLF's have been in excess of 70%, and averaged between 79 and 90%. Some other stations in the 60 MW category too were able to operate in excess of 70%. See Table 17. The 110 MW units of the Kothugudem Thermal Power Station (KTPS) should have operated above the levels they reached and

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[30]The attempt to have a thermal station in Kayankulam, would run up against the problem of land availability and pollution, which Kerala with its very high price of land can hardly afford. There is no option but to build hydel stations, and trade power with Tamilnadu where the land cost is not prohibitive. Gas based stations, would also come up against high price of land, and low tolerance to environmental pollution that a densely populated state with high incomes necessarily presents. The immediate solution may well be to set up a power plant across the hills in Tamilnadu with dedicated supply to Kerala. For such a decision the Kerala Government ought to be willing to forgo the benefit of the small addition to employment that a power generating plant creates, and instead minimise the use of its own high value land.

would have had supply side problems. Yet the assumption that is generally made, that PLF's of thermal units indicate their availability in a supply limited situation, is not really valid owing to (i) the effect of hydel supply which depends upon rainfall and the flow into the reservoirs, and (ii) system inadequacies, which limit the evacuation of power. For the APSEB, since hydel power is an important source, in years of good flow into the reservoirs we would expect the thermal units to be operated less lowering the PLF. During the years 1985-86 to 1989-90, the PLF on the average ranged from 64.82 to 76.23%. More than 55% of the year-wise variation in the overall PLF can be explained by the energy equivalent of net inflows into four reservoirs (Jalapat, Balimela, Donkarayi and Srisailam) which comprised roughly two-thirds of the hydel electric sources during this period. Only for these four reservoirs was the data available. In periods of good net inflows (inflows minus the withdrawal for power, weighted for the electricity content of each unit (TMC) of water), the PLF was low, and vice versa, giving a significantly negative coefficient for the regression. Thus we cannot reject the hypothesis that the PLF could have been higher in the years in which they were low. In short therefore for the base units (210 MW units, and 110 MW units) the achievable PLF was certainly higher than what is indicated in the Table 17, even as some units were supply constrained to operate at low levels. Thus, for an SEB like that of AP, during the perioc ler consideration the IIP policy of costing at a PLF of 68.5% would not have been acc Since then, the PLF of the APSEB has either increased or remained the same, above argument holds today.

Additional evidence in support of the above point is available in the performance data pertaining to BHEL supplied sets working with various utilities including the SEBs and the NTPC. BHEL sets constitute 76% of the total coal based thermal units in the country.[31] From Table 18 we observe that BHEL sets have outperformed other sets in terms of PLF, and operating availability. Our immediate concern here is to show that many sets used as base units, by the well performing SEBs and the NTPC have been steadily operating at PLFs in excess of the norm used of IPP's power. Recognising that 500 MW coal units would be used as base units, their PLF's have significance to problem at hand. Furthermore, for the South and the West, the PLFs on the wh BHEL sets) is in excess of 65%, so that a PLF higher than 68.5% for the base

[31]Recently, the share of BHEL in the capacity addition in thermal sets in India has been less than 70%, being of the order of 50-60%. Its contribution to higher rating sets 500 MW, 210/200 MW and 250 MW sets at 60% has been less. Thus the average age of BHEL supplied sets is likely to be more than that of non-BHEL sets, and the average size no larger. Thus the consistently higher PLFs of BHEL sets, across time and regions may be attributed to the superiority of their sets. So in using the data on PLF of BHEL sets we would not be able to dissociate the effect of utility related and supplier related factors. For our argument of a national alternative this is immaterial since the 'National alternative' developed later based on a large role for BHEL in equipment supply.

nearly guaranteed. (From Table 19 we see that the average PLF of 500 MW units of BHEL sets was in excess of 70%). Table 20 below which gives the distribution of BHEL supplied sets over PLF ranges further supports the above conclusion. Only two 500 MW units out of a total of 12 operated below 65% PLF, and as many as nine operated above 70%. For the 200/210 MW sets, not all of which are used as base units, and many are pretty old, there are many sets operating above 70% PLF. The operating availability of the 500 MW sets is close to 90 on the average for all regions, while that of the 210/200 MW units in the South and West are in excess of 80%.

It is interesting to examine the details of India's most efficient generating utility - the NTPC - since it has set a benchmark for others SEBs and IPPs to achieve. And if foreign parties are being allowed norms any less than what NTPC itself has been achieving, the argument for IPPs on grounds of operational efficiency fizzles out. On the count of generation alone, since NTPC is known to have achieved PLFs in excess of all SEBs (except possibly Rajasthan in recent years), the findings below (Table 21) are hardly surprising. All 500 MW units other than Farakka-4 during the year 1993-94 have achieved PLFs in excess of 70%, and the Singrauli Station vies with APSEB's Vijaywada Thermal Station in having consistently achieved very high PLFs. But NTPC's PLF could have been much higher had the norms of the Bulk Power Purchase Agreements (BPSA) been functionally crafted: The better performing SEB's find NTPC's cost of power high, so they have the incentive to back down NTPC stations rather than their own. The PLF used for costing in the BPSAs is generally of the order of 62.8%, which is not high enough. Had it been closer to 80%, for base units, the SEBs would have had little incentive to back down NTPC's units. NTPC'c claim that the financial norms (ROE at 12% for e.g.) are not in keeping with its own cost of capital, is quite true. The logical step would have been to enhance the financial return parameters for the costing of power of both SEBs and the NTPC, and to push the NTPC to as high a PLF as possible, while guaranteeing offtake. This lacunae in NTPC-SEBs agreements has not been systematically addressed [G. Sethu, 1993].

Section VIII: IPPs and the Cost of Capacity

We have already indicated that the cost of capacity of the proposed IPPs is high, and that it may be inversely related to the extent of foreign participation, since this in turn determines the extent of tying of equipment purchase and the higher cost at which equity has to serviced. It would be a moot point to examine the cost of capacity of NTPC's plants *today*. If the cost is significantly less than that of the IPPs, then the option of going via the NTPC (with a more functional BPSA) to add capacity is real and the Government's neglect of this option, exposes its ideological preference for foreign projects[32].

In Table 23 below we have computed the present (March, 1997) cost of capacity of NTPC's projects, based on the data available in various issues of the annual reports of the Ministry of Programme Implementation. For Kahalgaon I, Vindhyachal, NCTPP (National Capital Thermal Power Project) -I and Talcher I, since the projects had not been commissioned by end 1994, we had to work with the anticipated cost figures which are likely to be reasonable estimates of the final cost (verified for many other completed projects of the NTPC). For the others, which have been completed, the actual cost figures are used. Capacity addition in these stations have taken place in a phased manner, and given the time of implementation, we cannot take either the date of approval or the date of commissioning as the relevant point in time when the capacity was realised. Instead, we have the capacity adjusted date of commissioning which is the weighted average of the date of commissioning of the various units that constitute the station. We have assumed a norm of three years (quite close to what the data reveals) for the commissioning of a unit from the date on the start of the project: This gives the capacity weighted date of commissioning for a single unit of a station to be 18 months before the date of commissioning. For multiple unit projects, such dates are further averaged by the capacity of the individual units to arrive at the overall date for which the cost would be valid. A rate of discount of 10% has been used. In the next step the cost/MW as on the capacity weighted date of commissioning is brought to the present (March, 1997) by an assumed rate of inflation of 10%. In the next step, we have accounted for the time and cost overruns. As is expected, cost overruns with no time overruns increase the cost/MW today, whereas time overruns with no cost overruns decrease the cost/MW today. Finally we arrive at the upper bound of the cost/MW of capacity for NTPC projects Except in the case of Farakka, Kahalgaon I and Rihand they are all below Rs. 3 cr/MW today. All these projects include some transmission infrastructure, and township costs. In the earlier projects all associated transmission infrastructure is included. The Rihand project is way out of line since it includes the cost of the 1500 KV DC line from Rihand to Delhi, and the Kahalgaon and Farakka, particularly the latter have been plagued by problems on the labour front, typical of the Eastern region during that period. In any case

[32] Lately, NTPC, and the NHPC have been pushed into purchases from foreign equipment suppliers, as the Government on grounds of political expediency has been going in for the bilateral credit option, which has hurt domestic producers of electrical power generating equipment, since bilateral credit is inevitably tied. Even with such projects, since the operations are carried out by an efficient Indian company, there are no outflows on the operations cost of power.

the maximum at Rs. 3.6 crs/MW (excluding Rihand) and the mean at below Rs. 3 cr/MW, is well below the cost of the IPPs today.

We may further confirm these estimates independently. From the annual report of the NTPC, 31st March 1994. The operational capacity of NTPC as on that date was 14,529 MW. Let C be the cost of capacity as on 31st March, 1994. Assume this cost had been, and will be increasing at a rate equal 10% on account of inflation. Assume also that no major technical changes altering the cost and performance of equipment has taken place. Then, if a certain capacity m_i had been added i years ago, its contribution to historical aggregate cost of assets of NTPC is $Cm_i/(1+p)^i$. Therefore the effective value of NTPC's operational assets today $V = \Sigma\, Cm_i/(1+p)^i$; where p is the rate of inflation and the summation is over distinct additions to capacity. Knowing $\{m_i\}$, C can be worked out as in Table 22.

Thus, we work out the cost per MW of NTPC's capacity today to be of the order of Rs. 2.88 crs., which is a little lower than the figure we obtain going via a set of projects. This is because in the project data the cost of transmission lines are included whereas, in the computation above, since the hiving off of the Power Grid Corporation (PGC) from the NTPC, much of the transmission related assets have been passed on to the PGC. *Thus, IPPs have distinctly higher project costs, and the policy in using a low PLF for costing of power, puts the burden of their high returns on the utilities, which additionally in the case of the foreign financed IPPs would amount to a drain on the BOP. The IPPs are not planned to operate any more efficiently than the existing base units of the well performing SEBs and the NTPC, so there is no extra social gain which could have compensated the loss to the economy above.*

Section IX: A National Alternative

In this section we bring out a very important argument for a national initiative: The efficient and reliable working of BHEL provides the nation with a low cost and socially optimal alternative to either the IPPs or to bilaterally funded projects in the power sector. BHEL's forte is its 500 MW coal based thermal plant, which has the record of having the highest PLFs in various operating conditions. Their ability to use high ash content coal (up to about 40%[33]). The 210 MW units which during their induction in the early-seventies did pose teething problems, have been operating well since the eighties. BHEL has, on the twin basis of judicious import of technology and indigenous technology, been able to continuously update its products, and contain its costs. The

[33] Ash content at 40% is higher than what it can be. Mines not infrequently deliberately mix mud and stones with coal.

original price protection for BHEL under the import substitution regime, had defacto been given up in the eighties as large scale import of power generating equipment via tied bilateral credit emerged. Neverthleless the investible resources were more because of better financial position of the SEBs, and a greater degree of budgetary support. Moreover the World Bank itself was funding substantial power capacity, with the bids being subjected to international competitive tendering (and BHEL having a 15% price preference), meant that BHEL's market was not as constrained as it is today. With the lowering of import tariffs, the effective protection that BHEL enjoyed had come down substantially, and since 1991, BHEL may have been subject to negative effective protection rates. In the few recent instances of international competitive bidding (of World Bank sponsored projects) BHEL's bids have generally been the lowest, so that its 15% price preference, which in any case only counteracts the sales tax and other local duties, have hardly been availed off. Going by some of the recent contracts that BHEL has signed, its equipment is least 15% cheaper than competitors (though ABB with much local sourcing is catching up). In relation to projects not submitted to international competitive bidding it is about 25% cheaper at the very least.[34] We have argued elsewhere that there is little doubt about BHEL's quality and the features of its equipment [Morris, 1995]. Its performance in markets abroad (Malaysia, Malta, Cyprus and elsewhere), despite the handicap of not having had access to cheap and very patient credit that competing advanced country transnationals have, is ample evidence in this direction.[35] This is not surprising at all since India has one of the lowest cost of manpower particularly managerial and technical manpower. Where functional managerial hierarchies have emerged which are not averse to paying due attention to technology (which itself does not change too rapidly), the combination results in competitive pressure on advanced country transnationals. They have largely responded by taking advantage of their access to cheap capital. Without this compensating factor they would necessarily have to

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[34] The Vindhyachal Stage II Project (of the NTPC) involving the contribution of a greenfield power station which began in mid-1995 and is expected to be completed by the year 2001, in two stages, first 500 MW unit in 1997 and the second in early 2001. This project was won by BHEL, in international competitive bidding. The contract value is Rs 2753.40, which includes interest during construction, and BHEL expects to complete the entire project well within the cost of Rs 2.753 crs/MW, for a weighted average date of commissioning in mid-1988, (one year after the ENRON project's phase I). This makes the ENRON project at Rs 4.2 crs (Rs 3.74 crs excluding jetty costs) about 50% (36%) dearer! From inside sources we know that BHEL was not fully covering its costs, but even if all costs are covered the bid value should not have been higher by more than 12%, according to these very sources. Bids from competitors were much higher.

[35] BHEL, Telco and a few others in India, have the potential to emerge into global players. They had been handicapped by a policy that had for long discriminated against exports. Today, as this distortion has come down, inadeaquate and poor credit for exports is an important constraint. BHEL for instance, despite being qualified on technical grounds, has always come up against the credit limits posed by the combined networth of the Indian Exim Bank, itself, and the ECGC, in bidding for the really large projects internationally. Moreover, the relative underdevelopment of the rest of the economy for these firms lengthens their lead times and reduces the potential for out sourcing.

outsource from cheaper locations (including India) in the developing world and Eastern Europe. Independent LDC firms in power generating equipment including those in Brazil, South Korea and China are still at an early stage and need to build up the design capacity for large thermal plants[36]. Firms of the latter countries, but more so China with its stupendous home market, are fast catching up. Today, we have a situation where not only BHEL's exports are curtailed due to a policy that has so far not been able to create the special space for path breaking firms, but in its home ground itself the policy has actively discriminated against it. The IPP guidelines specify that 60% of the project cost be financed from sources other than Indian financial institutions. This acts against domestic producers of electrical equipment. *While the national concern for foreign exchange is understandable, it is entirely irrational to create a severe bias against domestic producers by shifting on them the task of arranging for foreign exchange and more so finance in general.* (Other aspects of the reform process particularly import liberalisation (under a level playing field), is no doubt vital in bringing about productive and allocative efficiency, and appropriate technology choice). This provision is contrary to the well recognised understanding that host countries can best minimize the negative externalities of foreign technology, and transnational activity and maximize their positive externalities and direct benefits by unbundling. The relevant point today is that when the time is ripe to realise the gains from having created an entity like BHEL, the present policy is running in reverse gear, as it set out to destroy an independent and competent electrical power generating industry.

In what follows we bring out the BOP differences between a typical foreign project and one domestically financed and operated. Taking the Dabhol Power Project (Phase I) as representative of a foreign power project, the cost is Rs. 4.2 crs/MW, as when the project goes on stream after a three year construction period. But this includes interest on loans during construction. The relevant computations are given in Table 24. With a cost advantage of 15% for the domestic producer (BHEL), and an import content of 20% in contrast to an import content of 80% for a foreign project, the net differential inflow of foreign exchange, during the construction period, of approx. Rs.2 crs/MW is being obtained at a service cost in dollar terms of above 28 per cent![37] Clearly therefore, the foreign power projects would impose a tremendous burden on the BOP. The analysis

[36]In the case of India the not inconsiderable size of the home market, the early initiative of the state in setting up the BHEL, the help provided the Soviet Union, and Czechoslovakia, were crucial environmental factors. The leadership provided by BHEL's managers at critical periods (as when the 210 MW sets were being stabilised) and later when they resisted governments attempt to bring about a comprehensive tie up of BHEL with Siemens, saw the company through.

[37]In other words when we trade an IPP for the National Project, the IRR on the differential foreign exchange flows is of the order of 28%; when all that is required to justify the Indian project is a positive IRR.

above does not take into account the added benefits and positive externalities of the nationalist alternative:

(i) In using up BHEL's excess capacities. This could have been incorporated in part by taking as the cost of the domestic project the variable rather than the total cost. With unutilized capacity (in large power equipment) in BHEL in 1994-95 of at least 50%[38]. Although the impact on the BOP would be marginal with this incorporation it has major implications for resource mobilisation.

(ii) Perhaps most important are the spillovers from the continued existence of a modern large (Chandlerian) enterprise in terms of skills development, the ability to take up large scale R&D, and force feed the industrial development of the country. Indeed, as newer transnational players like ABB and Siemens enter the Indian market to use it as a sourcing ground for electrical equipment exports: and the very IPPs themselves are heavily drawing upon the trained and skilled manpower from BHEL (and the NTPC) in large numbers at almost all levels. So far this turnover has not affected BHEL substantially given is vast pool of manpower and a large training infrastructure that is well integrated with its production and functions. But if the present discrimination against domestic producers continue, then BHEL (or its power equipment division) can potentially be disembowered and India would loose what [Khandwalla, P. 1990] has called 'a strategic' organisation which in the late twentieth century becomes necessary for the industrial transformation.

Why then has the State chosen to embark upon a policy that is so damaging to the nations economic interest? The answer no doubt has to do with the fiscal crisis of the state, but as we will argue a certain ideological position and the interaction of this ideology with the crisis is important. The fiscal crisis is by now well known. It arises due to its inability to cut revenue expenditures, or to raise the prices of infrastructural services including of electricity, and its total impotence to mobilise additional resources via taxes on the rich. As was expected by many economists in 1991-92, it has so far only been cutting capital expenditures. This has accelerated so that today the savings on capital account contribute to the revenue account! In power, budgetary contributions have

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[38]The 1994-95 annual report reveals that the capacity utilisation in certain key items of power generating equipment was as follows:

Thermal sets	14.76 %	Hydro sets	24.61 %
Boilers and auxiliaries	41.07 %	Industrial turbo sets	323.46 %

(Source: CIMM, CMIE>

It added a mere 1000 MW by way of thermal and hydel equipment, when it had an installed capacity of 4500 MW!! That BHEL has not turned sick is due to its extensive diversification, including lately into defence equipment contracts.

sharply fallen, and in short, to use the popular jargon there is simply no money with the government. While a tightening of the budgetary resources to its parastatals is expected in a period of structural adjustment, and becomes necessary to create the pressure for cost consciousness and commercial orientation [Morris, S., 1991], or even to soften them up for privatisation, in the power sector it would be entirely disastrous.

Power is the most critical input for agricultural and industrial production. The Governments own statements amply confirm that it is well aware that the "marginal productivity" of power in the rest of the economy is far greater than the cost of power. (Some what cynically, for the xenophiles, this would amply justify the foreign IPPs even if they are more expensive. And, it does because, even IPPs set up entirely with foreign capital and all equipment sourced from outside, is better than power cuts and shortages). This means that power development ought to be the topmost economic priority of the State. It also means that there is an opportunity for deficit financing of power projects, so that the required additions to capacity to match demand need not suffer for want of resources. Only a dogmatic monetarist position would insist on identifying the financial resources for power development with required savings for the economy as a whole. Deficit financing in the case of power (if tight implementation schedules can be adhered to) need not be inflationary given the extremely high marginal product of power in industry and agriculture. With the extra power availability if output can go up significantly, then the resources would be self financed for the economy as a whole, via the increased income generation. In other words, of the twin considerations (or near term objectives) in structural adjustment: expenditure switching and expenditure reduction, in an economy where the productive sector is fundamentally constrained by a critical supply side bottleneck (here power), and where removal of the bottleneck does not involve long gestation, the right policy would be major expenditure switching[39]. Overall expenditure reduction has to be tempered to accommodate the expenditure increase in overcoming the critical bottleneck. Assume that we need to start adding capacity in the first year of 5000 MW, which annually increased by 10% to provide for growth in demand[40]. Assume a cost of Rs 3.5 crs/MW, and in today's prices, we may project the savings constraint over the years. Investment goes up as $5000(1.1)^t*3.5$ Rs crs per year. The availability of depreciation funds as $\Sigma\ 5000*(1.1)^t*3.5/20$ from the fourth year onwards assuming a gestation period of 3 years for a typical power project. The surpluses available at a target rate of return of 12% would, similarly, from the fourth year onwards be, $\Sigma\ 5000*(1.1)^t*3.5*0.12$ The electricity available which when sold at Rs 2.0/KWH, at

[39] Which thanks to the curency depreciation and other policy initiatives on the trade front is on.

[40] We start with 5000 MW, rather than 6500 MW as per the CEA projections of requirement, because a substantial use of existing capacity through increased PLF, and refurbishment of equipment is possible.

a 80% PLF may be said to realise a savings of $2.0*e*sp$ where e is the amount of electricity sold and s the marginal propensity to save out of income, and p the 'marginal' productivity of electricity in terms of its own price. Thus the savings in the rest of the economy may be written as: $\sum 5000*(1.1)^{t}*365*24*0.80*2.0*0.40*p/10^{7}$ in Rs crs. Therefore the yearwise surplus or savings-investment, as a result of investment in electricity can be calculated. This becomes positive in the 7th year if p is 3; in the 5th year if p is 5 and, in the 3rd year if p is 8. For $p < 2.7$ or so, it always remain negative. For a 'marginal product' of electricity in the rest of economy of between two and eight times the price (Rs 2.0) of electricity, the amount of resources that needs to be mobilised in the sector and the rest of the economy is as in Table 25.

Table 26 brings out the deep crisis that has come about in the power sector as a result of the steep reduction in budgetary support. Observe that, despite the pressure on the Government to cut expenditures, it has not been able to make a significant dent in the growth of non-development expenditures. The expenditure on power has grown much more slowly, but what is even more revealing is that the net budgetary contributions, once allowance is made for the receipts from the power sector, has declined sharply in current price terms since the shift in policy. Over the years 1989-90 to 1991-92, the contributions had been increasing at a rate of 10% in nominal terms. This was also a period during which the inflation on power equipment was in the range of 8 to 9%. In real terms therefore, the contribution would have been just about maintained, so that the budgetary contribution in relation to the growth of capacity during this period of around 7% was declining. In the late eighties the capacity growth was around 10%. The decline in nominal contribution since 1992-93 was at a rate of 10% per annum, so that with an inflation rate which was of the order of 9%, the real contribution has been falling by about 19%. Not surprisingly capacity addition has fallen since the resources from [illegible] sources and from the private sector was not buoyant enough to fill in the gap. D[illegible] 1991-92 the total capacity addition including in non-utilities was at a rate of 5.2%, in 1[illegible] 93 at 5.4% and in 1993-94 at 5.0%. Since then it has apparently fallen even further, though firm data are not available. Capacity utilisation during the same period in terms of PLFs did not show any great improvement either. This is disastrous for an economy which is at a stage of development, where the (total) elasticity of electricity consumption with GDP growth is around one or more. And with some important constraints to growth having been overcome (primarily through the removal of the bias against exports, positive incentives for the private sector to grow, delicensing, and a weakening dependence upon agricultural performance), this underfunding is more than just one step backward in the process of reform.

The private sector has expressed its interest in a very large number of projects[41]. If these projects were to really materialise over the next five years or so then we would be clearly out of the woods. Since the cancellation of the Dabhol power project, the foreign parties are likely to lose interest. The high returns they were speculating upon, given the Power Policy Statement (vintage 1991-92), would be unrealisable if they come up for renegotiations and state officials are able to drive a hard bargain. Given the change in power policy recently (which stipulates competitive bidding), the scope for overpricing would fall. The private sector's interest, in co-generation, and in captive power generation would be unaffected, since the joint economies would far outweigh the decline in the expected returns to equity investments in power.

Section X: The Way Out

Our arguments in favour of a national alternative is not a call for a return to the past. It is obvious to every one that there can be no real improvement unless the State utilities improve. Wholesale privatisation of distribution (even if this is assumed to be desirable) is, at the present juncture, entirely inconceivable because the vested interests are very strong. Equally importantly the employees including the workers are hardly likely to quietly accept retrenchment or any conceivable VRS that the state can today put together. Without massive retrenchment, no private party would be willing to touch distribution. Sale of distribution and generation assets at values much below their current replacement cost to discount for the burden of labour to the private sector could have been a way out, but here again the government is likely to come up against vociferous criticism of a sell out, or of favouritism. Even a few instances of corruption or favouritism (most likely) have the potential to create acute embarrassment to the Government[42]. For significant privatisation, government would have to accept that it has to push through a comprehensive legislation laying down the method for privatisation, covering such aspects as preparation of units, corporatisation, valuation, pricing, concessions to employees etc. Without the involvement of Parliament, the process of privatisation, and of throwing open infrastructural areas for private participation, has the real danger in that particular groups and interests can use the "reform" process for primitive accumulation. This has happened in many a third world economy, where privatisation on ideological

[41]The private sector has expressed an interest in as many as 190 projects (75,000 MW) at a total cost of Rs. 276,000 crs approx. [CMIE, July, 1995].

[42]Already, in Telecom sector the government's initiative to throw open the sensitive and vital basic services to the private sector, though well crafted from the economic angle, has come up against vociferous criticism in Parliament, because the consultative political processes had not been gone through. Unfortunately for the country, the real issues are not being raised by the opposition. Right now a proxy war among the bidders, with the backing of competing international telecom giants, is being fought.

grounds have been pushed through without much concern for the process and fairness. In this matter the international agencies have little specific knowledge and there is no alternative to a deep understanding of the political and economic implications of privatisation. While other less democratic societies may have accepted unfair privatisation, strong political institutions in India would be able to thwart ad hoc measures being attempted without wide discussion and debate. The government so far has attempted to push through reform without attempting to build a wide consensus because of its weak position in parliament. But as the "reform" process enters the phase where it can hurt entrenched interests, nothing short of a comprehensive bill on privatisation and private participation in infrastructure would work. This is no doubt politically difficult, in the electricity sector, not the least because of the involvement of the state governments, so that in the near future the State has little option but to directly address the question of improvement in the SEBs. The stalemate that is likely would heighten the infrastructural constraint, affecting the growth process.

It is here that the Central Government can greatly influence and cajole the State Governments into moving away from the present dysfunctionality. The first step would of course be to considerably increase the levels of budgetary contributions, and to tie the same to performance measures[43] of the SEBs. The immediate concern being resource mobilisation for power, the Centre ought to base its contributions on the savings of the SEBs, rather than on distant criteria like the lack of overall development of the state[44]. This would put pressure on them to raise their tariffs in the short run, improve PLF and probably even come down on power theft. The setting up of the Power Finance Corporation is a step in the right direction, but its resources need to be greatly augmented even if through deficit financing.

The problems in hydel power development would have to be squarely addressed. Resettlement costs ought to be provided for. The 'public interest' litigation on such matters as seismic effects, and species loss, can be rationally addressed only if governments are willing to share information with the public at large. That governments

[43]These performance measures since they need be only relative (to other SEBs and over time), are not conceptually difficult. The first step would be to improve the accounting practises of the SEBs and to bring them under commercial audit, but these are minor problems.

[44]For too long the Indian State has adopted a criteria for Central funding that has punished better performance and rewarded poor performance. We have seen this in the case of power. But the situation is no better in other areas like railways, irrigation etc. It is a pity that the 10th Finance Commission has not addressed this issue of linking the Centre's development assistance to performance. The danger of increasing regional disparities in linking funding to performance has been overstated. Even in areas like health and welfare funding can be based on the product of need and temporal improvement. Funding that does not punish poor performance amounts to the management of underdevelopment and the underwriting of corruption.

today are secretive, is no doubt due to their need to avoid revealing their corruption (in the payoffs received from contractors and illegal favours granted). This has unfortunately tied the hands of a possible modernist and rational counter critique of the anti-hydro anti-large dam movement in India, one that derives much strength from its alliance with post-modernist movements in the West. Moreover we can hardly afford the luxury of legal tangles that prevent joint exploitation of water resources by group of states. Similarly, clearing the ground for large scale interstate movement of power[45] and of interstate investments in power generation by SEBs becomes vital in the optimal exploitation of coal[46] and water resources.

In September 1984, the Central Government launched a modernisation and renovation scheme for thermal plants of SEBs. Against a target additional generation of 7000 mKWH, about 10,000 mKWH were actually generated at a capital cost of 0.88 crores/MW. Later Phase II of the scheme and a similar scheme for hydel units was launched. But progress on these schemes were inadequate, due primarily to funds diversion by SEBs! As much as 6,500 MW can easily be realised though renovation at a cost of less than 1.3 crores/MW which is less than half the cost today of creating fresh capacity. This should have had the highest priority, but it does not, since the potential for kickbacks is practically nil! Can such a situation continue? See Table 27.

The problem of non-recovery and low prices in the supply of electricity to the agricultural sector is one that goes beyond the electricity sector: Despite the recommendations of several committees of inquiry,[47] the government has chosen to supply canal irrigation water at prices that do not even recover direct operational costs and well below the marginal productivity. This has created the basis for farmers who do not have access to canal water or who are denied the same, to insist that electricity be supplied at low rates, since on lift and well irrigation, the farmer who bears all other costs including capital. Many of these farmers also happen to be poorer than farmers with access to canal irrigation, so that an impasse has been created that prevents any

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[45]Besides the movement of power within the NTPC system (now via the Power Grid Corporation), the interstate export and import of power is quite small. There is large potential here given the skewness of distribution of both hydel and fossil energy resources.

[46]Pit head generations in the coal rich areas of MP and Bihar should be able to generate power at a variable cost that is as low as 50p /KWH, with a capital cost that is no larger than of a station elsewhere. Even with a transmission loss of 8% for long distance transmission (the technology for which is available in the country), the power can be available in areas as far away as Karnataka for a variable cost of just about 60p.

[47]The latest being the Committee chaired by Dr A. Vaidyanathan (1992), which has forcefully made the point and even outlined a method of implementation.

reasonable pricing of electricity to the agricultural sector[48]. The problem can hardly be tackled unless government initiates the processes to price irrigation water at reasonable rates. There is simply no basis to subsidise power to the household sector. Governments can easily increase the tariff on households, by linking up the tariff increase with a credible promise to improve power quality.

The reform process has so far (perhaps tactically) side stepped the problems of the coal sector and more specifically the problem posed by the illegitimate hold of the coal mafia on mining and supply operations. With the IPPs and a more liberal policy as regards the use of inputs in the power sector, a shift is likely from coal to fuel oil, naphtha, and gas, and imported coal, which would put additional pressure on the BOP. We have intentionally not built a critique of the IPP policy on this aspect of imported fuel dependency because in the long term India's power sector especially in the south and the West would have to substantially use imported gas. This becomes necessary because India is resource poor despite assumptions to contrary that are often made.[49] Yet there is still much scope to use indigenous coal even with its problem of high ash content. This can be seriously addressed only if there is willingness to tackle the mafia and the logistic problems of supply. If the initiative is not taken now the immediate load on the BOP, in import of fuels, may be unbearable even with much buoyancy on exports of manufactures.

The prospects that the real problems of the power sector would be addressed are rather dim given the enchantment of the present regime with private and foreign participation as a general solution to infrastructural problems. This approach can at best mitigate the bottlenecks in certain areas. Late industrialisation has historically demanded state intervention[50] particularly in infrastructure, and there is no reason to expect that India would be a special case. The need of the hour is for the state to focus on activities where it has the comparative advantage (infrastructure, social sectors like health and education, typical government functions like regulation, law and order) even as it quickly withdraws from direct participation in other areas where the private sector is eminently

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[48]We are grateful to YRK Reddy, Additional Secretary, Ministry of Finance, for this interesting insight.

[49]It is only India's very low level of development and (relatively) slow growth that has kept it demand for natural resources low. As it grows India like Japan is structurally constrained to place a large demand on the worlds natural resources, including fuels, which would have to be financed by surpluses on exports of manufactured exports.

[50]This is true of all late industrialisation expect perhaps some small European countries like Spain and Portugal which had the option to ride on growth impetuses elsewhere via their incorporation into the common market. The East Asian transformations, the Chinese and earlier the Soviet, Japanese and German, all fit the pattern highlighted by Alexander Gerschenkron [1966].

capable. The deep seated problems in the state electricity system, if left unaddressed can only grow and continue to be a drag on the economy and the well being of all.

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Table 1: The Dabhol Power Project -Some Salient Details

The Plant consists of 625 MW BASE and 70 MW Peaking giving a maximum possible generation of 695 MW. In combined cycle mode are 2 GTs (gas turbines) and 2 HRTSTGs (heat recovery steam turbo generators), and in the open cycle mode is one STG.

The total amount of electricity generated, net of auxiliary consumption is 633.4 MW (Base) and 725.2 MW (Peaking). The base output on the base capacity at 4.9275 million KWH is equivalent to a plant load factor of 90%.

The capital cost of the project was as follows:

	Rs. crs.
Land incl. building	78.40
Plant and machn.	1872.00
Additional taxes	48.00
Technical consultancy	35.20
Misc. fixed assets	51.20
Development fees	62.70
Preliminary expenses	547.26
Contingency	160.00
Working capital	87.72
TOTAL	3029.00

Other relevant features are as follows:

Capital cost /MW	Rs.4.48 crs /MW
Capital cost of Nagothane, Kaperkheda plants	Rs. 3.5 - 4.0 crs /MW
Jobs created	400 permanent
Jobs on construction	6000 during 3 yrs.
'Indirect' guarantee on equity at	16%
Likely ROE based on a PLF of 90%	28-30%
Tariff at 68.5% PLF restriction	Rs. 2.985/KWH
Tariff at 90% PLF	Rs. 2.40/KWH
Fuel Management Fee	Rs. 8.0 crs. p.a. (US$ 2.5 million)
Companies involved	
Enron Corp.	Bechtel Group Inc.
Enron Operations Corp.	Bechtel Power Corp.
Enron Oil and Gas Co.	Bechtel Mauritius Co.
Enron International Inc.	Power Enterprises Mauritius Co.
Enron Development Servcs.	GE Capital India Power Mauritius (I) Ltd.
Enron Mauritius	GE Electric Co.
Enron Gas Services	

Source: The Dabhol Power Comapny, (c.1995), "Dabhol Power Project in Global Perspectve", mimeo.

Table 2: Cost of Planned Power Projects, c. 1995, Including the IPPs			
Ownership	Capacity (MW)	Cost (Rs. crs.)	Rs. cr. /MW
Central Govt.	16002	57620	3.60
State Govt.	35635	93111	2.61
Joint Sector	2259	9544	4.22
Indian Pvt. Sector	25805	92605	3.59
Foreign	24878	99241	3.99
TOTAL	124579	352121	3.37

Source: CMIE, *India's Energy Sector*, July, 1995.

Table 3: Cost/MW for the Independent Power Projects for which MoUs have been Signed C, 1995										
Location	Thermal		Gas		Other Thermal		Hydel		All	
	Cost/MW (Rs Crs)	No.of Units	Cost/MW (Rs Crs)	No.of Units	Cost/MW (Rs Crs)	No.of Units	Cost/MW (Rs Crs)	No.of Units	Cost/MW (Rs Crs)	No.of Units
North	4.05	4		3	3.50	9	3.54	10	3.77	23
West	3.62	10	4.21	10	3.50	2	2.76	2	3.76	17
South	3.92	25	3.55	1	3.51	10	3.25	15	3.79	60
East	4.12	10	3.50	4	-		6.28	3	4.29	14
Northeast	..		4.47	18	3.50	1	2.98	2	3.49	7
All Above	3.90	49	3.86		3.51	22	3.59	32	3.83	121
Location unknown	3.50	1			3.50	1	-		3.50	2
	3.80	50	3.86	18	3.51	23	3.59	32	3.77	123

Source: CMIE, *India's Energy Sector*, July 1995.

Table 4: Dabhol Power Project: Financing and Some Implications for Balance of Payments	
	$ Millions
Total cost	910.0
Equity Capital	266.2
Indian Loan (Rupees, 17.5% payable in 9.5 yrs)	95.6
US Exim (8.4% payable in 8.5 yrs)	298.2
OPIC Loan (10% payable in 12 yrs)	100.0
Other ($) Loans (11% payable in 7.5 yrs)	150.0
Total Foreign Funding	814.4
Net inflow of dollars in 1st yr and construction period	718.9
Net inflow in 2nd year	95.5
Net inflow in 3rd to 7th year	170.1
Net inflow in 8th year	154.9
Net inflow in 9th year	114.2
Net inflow in 10 to 12 years	89.2
Net inflow in 13 - 30 years	74.5
Net inflow in 31st year	266.2
IRR on foreign funding (%)	18.3
Payback period (yrs)	5.1

Table 5: Some Aspects of the Electricity Generation and Distribution in the States				
	T&D Losses (%) 1993-94	T&D Losses (%) Average 1980-81 to 1993-94	Plant Load Factor of SEB (%) 1994-95	Change in PLF Since 1985-86
Haryana	24.5	24.2	44.7	I
Himachal	17.3	20.3	-	-
J & K	47.7	43.3	-	-
Punjab	19.2	18.8	56.7	N
Rajasthan	25.2	24.2	75.6	I
UP	23.2	24.6	58.8	I
Goa	27.6	24.2	-	-
Gujarat	20.0	22.7	61.3	I
MP	20.1	21.5	68.5	N
Maharashtra	15.8	16.3	61.1	I
Andhra	19.1	19.8	74.9	N
Karnataka	18.6	20.6	64.9	I
Kerala	21.0	23.0	-	-
Tamil Nadu	17.3	18.3	64.7	I
Bihar	22.0	22.3	20.0	D
Orissa	23.5	24.3	29.0	N
West Bengal	24.9	22.8	57.0	N
Sikkim	22.1	22.4	-	-
Arunachal Pradesh	31.6	29.0	-	-
Assam	20.8	21.8	26.7	N
Manipur	22.5	29.5	-	-
Meghalaya	10.7	10.4	-	-
Mizoram	28.0	33.3	-	-
Nagaland	23.1	24.7	-	-
Tripura	29.5	30.2	-	-
NORTH	26.18	25.9	59.0	-
WEST	20.88	21.18	63.6	-
SOUTH	19.00	20.42	68.2	-
EAST	23.13	22.95	35.3	-
NORTHEAST	23.74	25.56	26.7	-

(I-increase; D-decrease; N-no significant change)

Table 6: Dues Payable by SEBs to Central Power Corporations, and NTPC, February 1995				
	NTPC (Rs Crs)	CPCs (Rs Crs)	Dues to NTPC/Total Sales (Paise/KWH)	Dues to CPCs/Total Sales (Paise/KWH)
Haryana	305.97	471.33	38.8	59.8
Himachal Pradesh	15.69	31.97	13.3	27.1
J & K	256.68	311.02	159.7	193.5
Punjab	25.23	55.32	1.7	3.8
Rajasthan	139.28	205.66	12.4	18.4
Uttar Pradesh	832.2	1342.7	35.6	57.5
Delhi	357.1	449.8	45.3	57.1
Goa	1.5	0.1	2.2	0.2
Gujarat	60.0	52.6	2.7	2.3
Madhya Pradesh	199.2	276.8	10.8	15.1
Maharashtra	88.3	80.9	2.4	2.2
Andhra	91.3	131.4	4.2	6.0
Karnataka	42.4	46.0	3.0	3.3
Kerala	30.41	37.61	4.9	6.0
Tamil Nadu	72.3	93.1	3.5	4.5
Bihar	333.5	1233.3	38.4	142.2
Orissa	62.73	122.39	10.5	20.5
West Bengal	53.2	380.1	5.0	35.9
Assam	-	154.4	-	103.7

Sales refer to final sales by SEBs and utilities to ultimate consumers.

Table 7: Some Aspects of the Power Sector - A Regional View

	Items	North	West	South	East	NE	India
1	Peak shortfall (%);avg. 1991-92 to 1994-95	16.80	13.00	21.50	29.40	30.00	18.50
2	Energy shortfall (%);avg. 1991-92 to 1994-95	6.50	4.50	9.30	15.00	10.90	7.60
3	Avg. PLF(%) of SEBs thermal plants; 1991-92 to 1994-95	57.10	59.40	63.78	31.60	23.90	-
4	Additional avail. from SEBs thermal plants at 65% PLF, as percent of total reg. gen.	7.62	5.72	0.18	43.94	91.67	9.22
5	Centre's share of capacity to total regional capacity (%)	38.99	22.68	23.85	40.42	27.77	27.15
6	SEBs capacity, 31st March (MW)	14534	18789	14819	7330	926	56398
7	Central capacity, 31st March (MW)	9287	5512	4640	4972	356	24767
8	Addition to cap. by SEBs, 1992-93 to 1994-95 (MW)	1559	1826	1805	1019	120	6328
9	Addition to cap. by Centre, 1992-93 to 1994-95 (MW)	2070	1626	420	2130	101	6347
10	(8)/((6)-(8)) (%)	12.24 (3.85)	10.76 (3.47)	13.87 (4.42)	16.14 (5.11)	14.89 (4.74)	12.64 (4.04)
11	(9)/((7)-(9)) (%)	28.64 (8.77)	41.84 (12.34)	10.00 (3.21)	74.95 (20.49)	39.33 (11.69)	34.45 (10.37)

Figures in brackets are average annual compound growth rates

Table 8: Estimated Purchases from Central Power Corporations (CPCs) by SEBs in the Region, and Dues Payable by SEBs to CPCs, 1994-95			
Region	Estimated purchases from CPCs* (mil. KWH)	Dues to CPCs (Rs.crs.), 31 March, 1995	Dues per KWH of Est. Purchases (paise)
North	48659	2442.19	50.19
West	28445	344.87	12.12
South	25497	236.22	9.26
East	24675	1323.98	53.65
North-East	933	147.17	15.21

* NHPC, NTPC, DVC, NEEPC; NTPC generation at assumed PLF of 69.8%, DVC's at 40%, NHPC's at 50% and NEEPC's at 30%.

Table 9: Captive Power Generation and Utilities in the States				
	Captive PPs Capacity 1993-94 (MW)	Captive/HT (%)	Captive/IND = (HT+LT) (%)	Captive/ Total (%)
NORTH	1979.8	73.9	47.7	14.5
WEST	2454.0	44.1	36.0	15.6
SOUTH	2219.0	54.3	45.0	17.4
EAST	2921.2	117.5	104.0	57.6
NORTHEAST	330.6	428.8	171.1	70.1
INDIA	9904.5	66.5	52.3	20.8
Haryana	314.9	129.7	91.5	19.9
Punjab	179.4	23.2	17.1	6.2
UP	958.4	127.1	79.0	20.5
Gujarat	763.5	53.1	47.9	20.7
Maharashtra	732.5	27.3	23.1	9.9
Andhra Pradesh	812.6	65.6	55.5	18.6
Tamil Nadu	758.4	51.3	41.7	18.2
Bihar	929.1	87.4	83.9	53.3
Orissa	1260.5	232.2	186.4	105.5
West Bengal	730.2	82.9	71.4	34.4

Captive generation is estimated at the national average PLF for such plants, c. 1993-94 of 57.0%; HT & LT refer to electricity sales of utilities to high and low tension consumers respectively.

Table 10: Some Aspects of the Power Industry In Select OECD Countries c.1990						
Region/ Country	Hydel /thermal ratio (%)	Price household /Price industry (%)	Avg. trade ratio (%)	PLF of thermal utilities (%)	Autoproducer's gen. / utility gen. (%)	Total installed capacity (MW)
North America	26.35	0.60	2.28	31.84	0.78	794610
Pacific	17.84	0.72	0.00	37.25	9.07	236350
Europe	39.61	0.57	14.54	24.56	9.25	559760
Germany	5.63	0.56	11.56	38.50	16.03	97700
Finland	44.78	0.61	21.02	24.36	15.56	13220
Italy	17.40	0.62	17.10	42.24	15.10	56550
UK	2.06	0.65	3.80	40.54	5.38	73050
France	109.50	0.38	14.12	5.84	8.65	74780
US	13.54	0.61	1.44	34.50	0.00	690470
Canada	264.53	0.07	7.47	13.07	6.25	104140
New Zealand	286.76	0.58	0.00	12.83	0.00	7190
Japan	15.97	0.69	0.00	36.46	11.23	194730

Table 11: Ratio of Tariffs to Different Consumers / Tariffs to Households (%) c.1994						
Region /State	Tariff to Households (paise/KWH)	Commercial (%)	Agricultural (%)	Small industry (%)	Medium industry (%)	Large industry (%)
Haryana	97	220	37	183	186	207
HP	60	233	67	133	183	193
J&K	55	167	22	89	89	89
Punjab	115	157	40	121	134	153
Rajasthan	83	212	51	164	212	230
UP	38	382	73	508	553	642
Goa	75	202	67	160	133	237
Gujarat	185	219	33	125	141	171
MP	73	253	38	158	214	318
Maharashtra	111	244	21	135	259	233
AP	91	229	22	143	230	263
Karnataka	152	255	-	109	106	150
Kerala	72	347	20	145	141	146
Tamilnadu	90	250	-	217	237	217
Bihar	100	449	29	155	139	213
Orissa	83	184	67	127	151	230
West Bengal	85	254	72	237	301	243
Assam	85	206	94	56	147	194
Source: CMIE, July 1995.						

Table 12: Some Aspects of Electricity Demand in the States						
	Domestic Power Consumption per capita (KWH)	Dom. Con. per cap. for connected households	Households with Electricity (1991) (%)	Electric Pumpsets/ 1000 population	Energy consumed/ pumpset energised (KWH)	Agri Power Con. per capita (KWH)
Haryana	94.2	133.9	70.35	24.5	9824	240.5
Himachal	60.5	69.5	87.01	0.7	3425	2.7
J & K	50.9	67.9	75.00	0.4	81713	34.8
Punjab	102.1	124.0	82.31	33.5	9352	312.9
Rajasthan	35.2	100.5	35.03	10.0	8342	83.2
UP	37.2	169.8	21.91	5.2	12332	64.4
Goa	144.4	170.5	84.69	4.6	1502	6.8
Gujarat	60.7	92.1	65.93	13.0	16096	209.8
MP	42.4	97.9	43.30	15.9	5388	85.6
Maharashtra	81.9	118.0	69.40	23.5	4809	113.0
Andhra	49.3	106.5	46.30	23.3	6011	140.2
Karnataka	50.4	96.1	52.47	21.2	6420	135.8
Kerala	71.7	148.1	48.43	9.7	924	9.0
Tamil Nadu	59.8	82.7	72.29	26.4	3852	101.7
Bihar	6.6	52.5	12.57	3.1	5578	17.1
Orissa	46.7	74.5	62.73	2.0	5291	10.8
W Bengal	38.4	72.2	53.22	1.4	8119	11.7
Assam	12.7	67.7	18.75	0.2	10340	1.7

Table 13: Are Hydel Capacities (and PLF of Thermal Stations), the Key to Lower Power Costs?

Regression of log(cost; paise/KWH) on hydel/thermal capacity (%) and on log(PLF) for the year 1993-94, reveals:

$$log(cost) = 6.58 - 0.186 * (hydel/thermal\ capacity\ \%) - 0.346 * log(PLF\ \%)$$

No. of Obs.	14	t(hydel/thermal)	-2.64
Adj R-sq.	0.529	t(PLF)	-2.41
R-sq.	0.602	F-ratio	8.32
t(constant)	12.04		

Table 14: Major Factors in the Delay of Central Public Sector Power Projects (No of projects affected)			
	As on 1.1.92	As on 1.1.94	As on 1.1.95*
Funds constraint	8	13	15
Land acquisition: Forest	7	7	2
Non Forest	9	6	4
Environmental clearance	4	3	1
Technology: Selection	0	0	0
Agreement	1	1	0
Award of contract	8	3	7
Equipment supply: Indigenuous	2	5	3
Imported	6	4	2
Civil Works	6	8	9
Government clearance	3	16	13
Geological and mining problems	1	3	1
Other*	21	15	15
ALL FACTORS ABOVE	76	84	72

* Includes law and order, slow progress of court cases, inadequate infrastructure, and bad weather

Table 15: Status of Existing and Planned Hydel Schemes of the Kerala SEB, c.1989

Schemes	Inst. cap. (MW)	Firm Power at 100% load (MW)	Annual genr. potential (mU)	Per cent of total	Remarks
Completed/existing	1477	577	5050	32.0	
Under execution	261	206	1802	11.5	to be completed over '88-89 to '90-91
Pending sanction	427	132	1156	7.3	Forest clearance principle hurdle
Pending interstate agreement	700	197	1726	11.0	unlikely in next five years
Dropped /sanction rejected	1025	374	3276	20.7	all except Perinjakutty (60 MW) rejected on environmental grounds
Remaining exploitable	1231	315	2759	17.5	DPR's being prepared
ALL IDENTIFIED	5120	1800	15768	100.0	

Source: State Planning Board "Report of the Task Force on Power Generation: Hydro-Electric Projects - VIII Plan", Govt. of Kerala, May, 1989, Trivandrum

Table 16: Planned Micro /Mini /Small Hydro-Electric Schemes of the Kerala SEB					
Expected Yr. of Comm.	No. of Units	Avg. size (MW)	Inst. Cap. (MW)	Energy (MU)	Utilisation factor (%)
1990-91	2	2.25	4.50	12.00	0.30
1991-92	4	2.88	11.50	54.00	0.54
1992-93	8	1.03	8.25	28.40	0.39
1993-94	5	6.70	33.50	62.00	0.21
1994-95	10	6.43	64.25	149.00	0.26
1995-96	9	7.00	63.00	130.00	0.24
1996-97	8	3.81	30.50	57.00	0.21
1997-98	18	3.01	54.20	180.40	0.38
1998-99	25	2.32	58.03	180.12	0.35
ALL ABOVE	89	3.68	327.73	853.02	0.30

Source: State Planning Board, "Report of the Task Force on Power Generation - Hydro-Electric Projects: VIII Five Year Plan", May, 1989, Govt. of Kerala.

Table 17: PLF of APSEB's Thermal Units (%, 1985-86 to 1989-90)						
Unit	Rating MW	85-86	86-87	87-88	88-89	89-90*
VTPS - 1	210	90.39	91.58	91.64	77.91	89.40
VTPS - 2	210	87.36	89.20	93.31	90.80	71.70
VTPS - 3	210	88.88	90.39	92.48	88.36	79.40
Avg. of above	210	88.87	90.39	92.47	85.69	80.17
KTPS - 1	60	72.84	63.52	74.80	38.80	82.40
KTPS - 2	60	65.73	26.11	87.36	80.00	74.70
KTPS - 3	60	73.68	67.46	37.31	54.70	74.50
KTPS - 4	60	3.67	75.70	74.45	76.50	32.30
KTPS - 5	110	43.10	44.08	62.13	64.20	48.70
KTPS - 6	110	28.97	44.98	63.40	60.60	58.70
KTPS - 7	110	54.07	63.90	66.37	47.30	67.80
KTPS - 8	110	55.96	65.87	73.69	65.60	40.50
RTS B	62.5	90.06	79.60	71.18	71.20	45.80
NTS	30	45.34	63.60	65.76	62.80	54.00
All Thermal Units		64.82	69.71	76.23	69.50	65.70

(* up to Feb. 1990; VTPS - Vijaywada Thermal Power Station; KTPS - Kothugudem Thermal Power Station; RTS - Ramagundam Thermal Power Station; NTS - Nellore Thermal Station, VTPS -3 was commissioned in the year 1989-90)

Table 18: PLF & Operating Availability of BHEL and All other Generating Sets				
Year	PLF		Operating Availability	
	All	BHEL	All	BHEL
1990-91	53.8	55.8	71.1	71.7
1991-92	55.3	56.8	72.0	72.7
1992-93	57.1	59.0	73.0	74.6
1993-94	61.0	62.8	76.4	77.0
1994-95	60.0	61.4	77.2	77.5
Source: Operations During 1994-95: An Overview, BHEL, mimeo, 1995.				

Table 19: Average PLF of BHEL supplied Units (%, 1994-95)				
Type	North	East	West	South
500 MW	80.5	-	71.20	79.4
200/210 MW	62.3	60.7	65.0	71.6
Overall (incl.60 MW)	58.1	45.3	65.1	71.1
Source: Operations During 1994-95: An Overview, BHEL, mimeo, 1995.				

Table 20: Distribution of Units over PLF ranges, Average PLF and Operating Availability of BHEL supplied sets (1994-95)							
	500 MW			200/210 MW			
	North	West	South	North	East	West	South
Installed and stabilized (nos.)	2	7	3	29 (4)	13 (0)	40 (6)	21 (2)
PLF < 65% (nos.)	0	2	0	14	8	18	6
65 ≤ PLF < 70 (nos.)	0	1	0	4	1	9	4
70 ≤ PLF 80 (nos.)	1	0	2	7	2	10	3
PLF ≥ 80 (nos.)	1	4	1	4	2	3	8
Average PLF (%)	80.5	71.2	79.4	62.3	60.7	65	71.6
Operating availability (%)	91.0	87.1	91.3	73.4	75.5	80.5	81.2
(Figures in brackets are the number of units that are 15 or more years old; The East did not have any BHEL commissioned 500 MW sets) Source: Operations During 1994-95: An Overview, BHEL, mimeo, 1995.							

Table 21: Plant Load Factor of Some Important NTPC Units (%)				
	Unit Rating (MW)	1991-92*	1992-93**	1993-94**
Singrauli	1 (200)	87.54	91.13	84.33
	2 (200)	..	90.25	72.99
	3 (200)	82.74	75.09	81.27
	4 (200)	88.41	92.37	..
	5 (200)	88.83	91.47	84.29
	6 (500)	78.67	..	84.25
	7 (500)	..	86.11	..
Korba	1 (200)	78.18	78.10	81.64
	2 (200)	..	88.89	75.41
	3 (200)	87.46	..	..
	4 (500)	75.71	77.71	88.13
	5 (500)	..	74.76	74.69
	6 (500)	..	77.94	79.10
Ramagundam	1 (200)	..	84.52	..
	2 (200)	..	84.08	..
	3 (200)	..	80.97	77.09
	4 (500)	..	..	74.34
	5 (500)	..	76.26	..
	6 (500)	..	81.26	74.28
Vindhyachal	1 (210)	78.48	70.46	74.60
	2 (210)	..	74.16	71.52
	3 (210)	..	77.61	71.54
	4 (210)	..	87.02	87.57
	5 (210)	..	..	..
	6 (210)	70.60	86.86	83.96
Farakka	1 (200)	..	..	84.56
	2 (200)	73.35	..	77.52
	3 (200)	..	79.57	..
	4 (500)	Not comm.	Not comm.	..
Rihand	1 (500)	78.14	..	71.54
	(500)	..	81.48	..
Unchachar	1 (210)	..	..	..
	2 (210)	..	76.29	..
Auraiya	1 (112 GT)	73.97	..	..
	2 (112 GT)	..	..	..
	3 (112 GT)	..	..	..
	4 (112 GT)	..	..	..
	5 (102 ST)	79.52	..	..
	6 (102 ST)	..	..	..

(* Up to December 1991; ** Up to November 1993 or 1994; .. Less than 70%)

Table 22: NTPC's Cost of Capacity Today (end March, 1997)		
1.	Operational capacity, i.e., capacity already commissioned (31st March, 1994)	14,529 MW
2.	Fixed assets at original cost (31/3/94) (Rs.crs)	21,428.49
3.	Capital work in progress (31/3/94) (Rs.crs)	8,084.40
4.	Operational fixed assets: [(2)-(3)] (31/3/94) (Rs.crs)	13,344.09
5.	Current assets financed from long term sources (31/3/94) (Rs.crs)	4,735.96
6.	Effective original value of NTPC's assets: V, [(4)+(5)] (31/3/94) (Rs.crs)	18,080.05
7.	Capacity of NTPC discounted by the inflation rate of 10% p.a. = $\Sigma m_j/(1+.1)^j$.	8,355.30 MW
8.	Cost per MW C = [(6)/(7)] (31/3/94) (Rs.crs/MW)	2.16 (2.12)*
9.	Cost per MW end March, 1997 at an assumed inflation rate of 10% p.a. $C(1+.1)^3$ (Rs.crs/MW)	2.88 (2.81)*
(*excluding township costs)		

Table 23: Cost of Some NTPC Projects Today

Project	Year of Commis-sioning*	Capacity Weighted Yr of Comm	Capacity MW	Total Cost (Rs crs)	Cost/MW (Rs crs)	Time Overrun in years	Anticipated Cost (Rs crs)	1997 Cost/MW unadjusted (Rs crs)	Time & Cost overrun adjusted 1997 cost/MW (Rs crs)	Cost overrun adjusted 1997 Cost/MW (Rs crs)	Upper bound of 1997 Cost/MW (Rs crs)
1 Singrauli	1988	1985.9	2000	1380.3 954.6	0.7			2.0			2.0
2 Korba I	1988	1986.0	1100	919.2	0.9			2.5			2.5
3 Korba II	1990	1989.5	1000	1196.2	0.9			1.9			1.9
4 Ramagundam I	1989	1987.2	1100	784.4	1.1			2.8			2.8
5 Ramagundam II	1990	1990.0	1000	761.4	0.8			1.5			1.5
6 Farakka I	1988	1987.7	600	700.0	1.3			3.1			3.1
7 Kahalgaon I	1994	1993.0	840	1628.2	2.0	2.8	2037.5	3.0	2.7	3.6	3.6
8 Vindhyachal I	1992	1990.2	1260	2729.0	1.3	1.3	1628.2	2.5	2.2	2.5	2.5
9 Rihand I	1990	1989.5	1000	1317.0	2.7			5.6			5.6
10 NCTPP I	1994	1993.0	840	1481.5	1.6	0.5	1595.7	2.3	2.7	2.8	2.8
11 Talcher I	1996	1995.5	1000		1.5	0.1	2549.8	1.7	2.9	2.9	2.9

* Anticipated in case of Nos. 8, 9, 11 & 12.

Table 24: The Internal Rate of Return of the Difference In the Foreign Exchange Flows between a Nationalist Alternative and an Enron like Project (unless other-wise stated in Rs crs /MW)		
	Item	
1.	Average interest on foreign debt on Foreign Project (FP): *i*	10.00%
2.	Project cost (FP) : *FPC*	4.2
3.	Foreign equity (wholly owned foreign project) (Debt:Equity::2:1)	1.4
4.	Net project cost of FP = *FPC(1+i/2)/(1+3i/2)*	3.83
5.	Plant cost of FP = (4)*0.65	2.49
6.	Foreign sourced plant plant: 0.80*(5)	1.99
7.	Foreign finance	3.50
8.	Net foreign finance: (7)-(6)	1.51
9.	Foreign finance service rate, average on debt and equity	18.00 %
10.	Net Indian project cost = 0.85*(4)	3.26
11.	Indian plant cost: (10)*0.65	2.12
12.	Foreign exchange for Indian plant (imported components and cost of techn. purchase): (11)*0.20	0.42
13.	Interest on above (at an assumed cost of borrowing of 12% during construction)	0.076
14.	Differential inflow of foreign exchange between the two alternatives (8)+(12)+(13)	2.01
15.	Equalised annual outflow of foreign exchange on service of debt and equity earnings at an average rate of 18%, being the IRR on exchange flows for a foreign financed project; for 30 years.	0.63
16.	Equalised annual outflow of foreign exchange on debt service @ 12% for commercial borowings for financing the foreign exchange component of the Indian project, over 30 years	0.04
17.	Equity to be retired in the 31st year, for the Foreign Project	1.4
17.	**IRR of the differential foreign exchange flows**	**28.31%**
	IRR of the differential foreign exchange flows at a cost advantage of 20% for the domestic producer, and ceteris paribus	28.91%

Table 25: Net Savings Required (Rs '000 crs) for Alternative Assumptions about the Marginal Product of Electricity				
Year	MP=2	MP=3	MP=5	MP=8
0	17.5	17.5	17.5	17.5
1	36.7	36.7	36.7	36.7
2	5.9	5.9	57.9	57.9
3	58.6	48.8	38.9	0.3
4	59.3	38.7	18.2	-64.2
5	60.2	27.7	-4.72	-134.6
6	61.1	15.6	-29.9	-212.0
7	62.1	22.7	-57.6	-297.2
8	63.3	-12.41	-88.1	-390.9
(Negative sign implies savings surplus)				

Table 26: Combined Expenditure of the Central and State Governments (All Items excl. transfers, Power, Development and Revenue, and Revenue Receipts from the Power Sector (Rs.crs or Index:1989=100)								
Year	Total excl. trnsfr.	NDE	DE	DE Power	DE Power Revn.	DE Power captl.	Recpt. Power	Net. contr. power
								(Rs.crs.)
1989	126763	59405	67358	3711	1063	2649	-391	3039
1990	143196	69195	74000	4071	887	3184	-319	3504
1991	165024	81028	83996	8241	5030	3211	-446	3657
1992	187095	97063	90031	4321	1958	2362	-450	2812
1993	215168	115251	99917	6472	3410	3062	155	2907
1994	237358	127176	110182	5301	2183	3118	383	2735
								(Index 1989=100)
1989	100	100	100	100	100	100	100	100
1990	113	116	110	110	83	120	82	115
1991	130	136	125	222	473	121	114	120
1992	148	163	134	116	184	89	115	93
1993	170	194	148	174	321	116	-40	96
1994	187	214	164	143	205	118	-98	90
(NDE: Non-Development Expenditure, DE: Development Expenditure)								

Table 27: Modernisation and Renovation Scheme for Thermal & Hydel Power Plant: Some Details

Launched in Sept 1984 for thermal stations
and in Sept 1987 for hydel stations

Phase I

34 PPs 164 units 13,556 MW capacity Cost Rs 1174 crs

Expected additional generation		:	7000 million units
		=	799 MW
		=	1331.8 MW at assumed PLF of 60%
'Capacity Addition' cost		=	0.8815 cr/MW of cap. created at assumed PLF of 60%
Actual generation	88-89	:	11,000 MU
	89-90	:	10,800 MU
	90-91	:	10,700 MU
	92-93	:	10,462 MU
	93-94	:	10,938 MU

Phase II Launched in 1991-92

47 PPs 212 units 21,671 MW capacity Cost Rs 2105 crs

Expected additional generation	:	8,750 MU
(which improves the PLF by 5% points from 51.5% to 56%)		
	=	998.86 MW
	=	1664.76 MW at PLF of 60%
'Capacity Addition' Cost	:	Rs 1.26 cr/MW

Hydel Scheme

55 Hydel Stations 209 units 9658 MW Cost Rs 1260 crs
Expected additional generation : 6,709 MU

Out of total of 1163 Nos of activities under CLA (Central Loan Assistance), 1094 (94.01%) completed.

Under SP (State Plan)/OR (Own Resources) 470 has been completed. This is 78.33%

Reasons for below target performance

- Inadequate flow of funds from state governments
- Non-availability due to shut down of units
- Accidents
- Overall power shortage
- Managerial inefficiencies

Figure 1

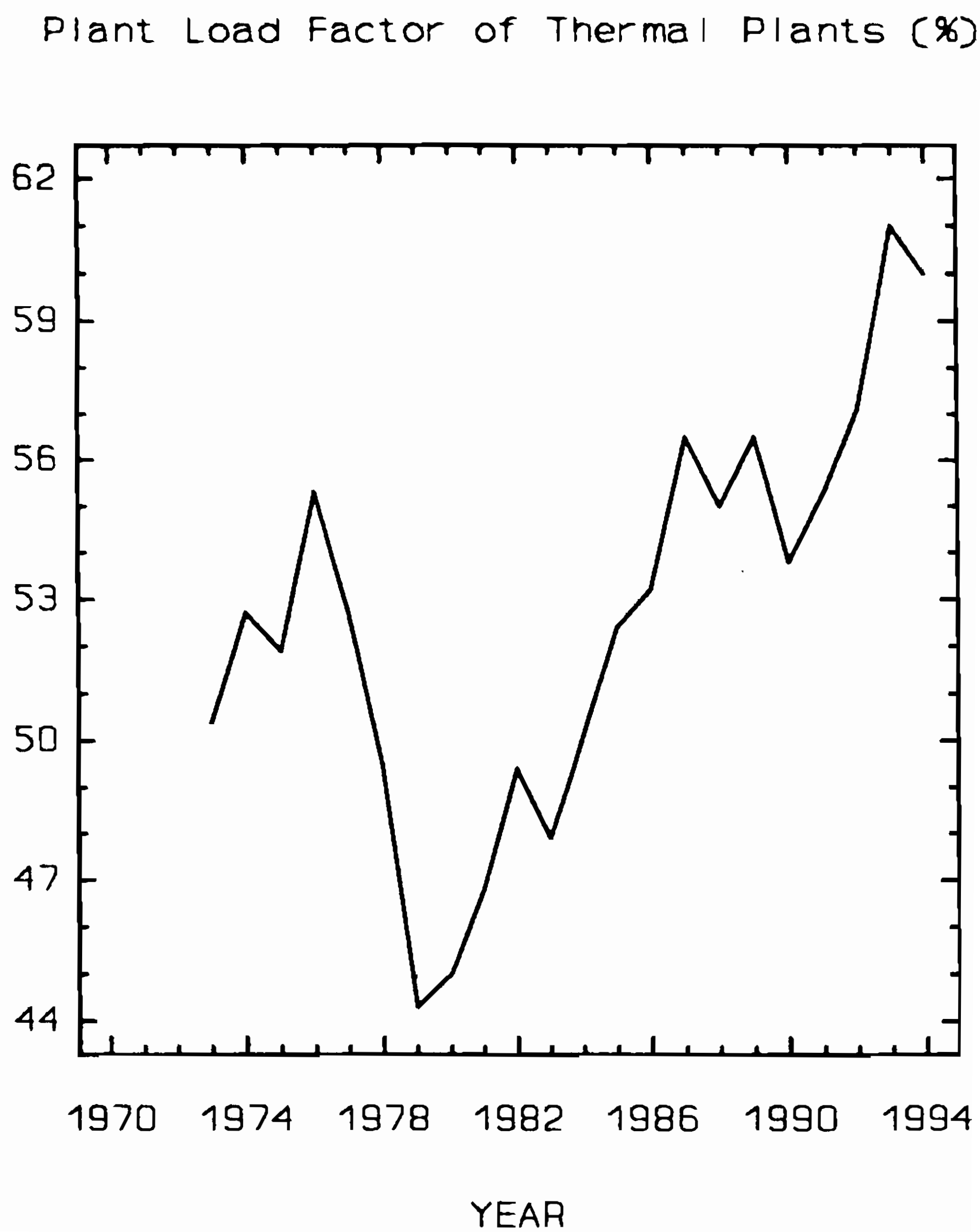
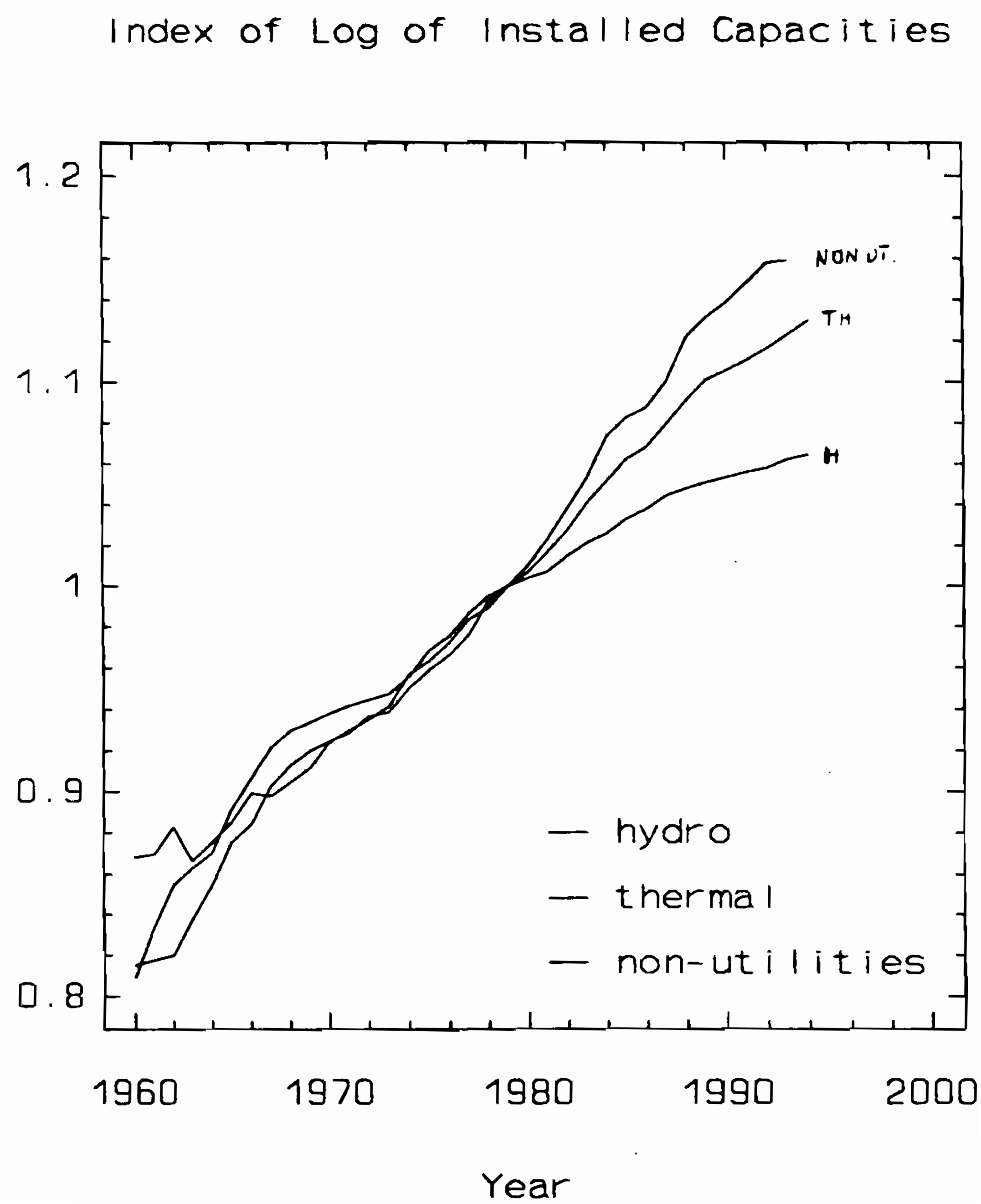

Plant Load Factor of Thermal Plants (%)
62
59
56
53
50
47
44
1970
1974
1978
1982
1986
1990
1994
YEAR

Figure 2



Index of Log of Installed Capacities
1.2
1.1
1
0.9
0.8
1960
1970
1980
1990
2000
Year
NON UT.
TH
H
hydro
thermal
non-utilities

Figure 3

Index of log of Elec. sold by Utilities (1979=1)