PLIGHT OF THE POWER SECTOR IN INDIA: SEBs AND THEIR SAGA OF INEFFICIENCY

K. P. Kannan
N. Vijayamohanan Pillai

Working Paper No. 308

November 2000

PLIGHT OF THE POWER SECTOR IN INDIA : SEBs AND THEIR SAGA OF INEFFICIENCY

K.P. Kannan
N. Vijayamohanan Pillai

Centre for Development Studies
Thiruvananthapuram

November 2000

This paper is part of a larger study on the problems of the power sector in India with special reference to Kerala. We are thankful to K N Raj and A K N Reddy for support and encouragement; to M N V Nair, V Ramachandran, K S Menon, and S B K Menon for discussion and comments on an earlier draft; to V Santhakumar for his participation in the early phase of the study; to T L Sankar, J Vasudevan, Sonkar and Rakesh Mohan for discussion and help in obtaining relevant materials. We would also like to thank our colleagues, especially K. Pushpangadan, at the Centre for Development Studies, Thiruvananthapuram for their

ABSTRACT

True to the spirit of a social-democratic State, India had originally evolved her power development policy, and shouldered that responsibility, in line with the State's professed commitment to honouring and ensuring social security equations. Though the State Electricity Boards (SEBs) were statutorily required to function as autonomous service-cum-commercial corporations, they became in effect agents of the Governments to subserve the socio-economic policies of the State, and hence never felt the requirement to break even or to contribute to capacity expansion programs. This unaccountability culture in turn led to gross inefficiency at all levels – technical, institutional and organizational, as well as financial. And the cost escalation from such pampered inefficiency remained above the revenue realized from an irrational subsidized pricing practice. With losses mounting up, the field was getting cleared for some new entrants of ideas and practices, that the so-called 'fiscal crisis' at the turn of the nineties ushered in subsequently. Thus has commenced an era of reforms and restructuring of power sector in India, at the initiation of the World Bank that has also lit up an informed atmosphere of debates and discourses. However, little light has been thrown on the significant aspects of inefficiency costs involved in the SEBs' forced functioning that allegedly finally warranted the reforms. The present study is a modest attempt at this. Here, inter alia, we have estimated, on some very plausible assumptions, the avoidable cost of inefficiency at a few amenable levels and found it to represent about one-third of the reported cost of electricity supply in India in 1997-98 ! And this is regardless of a number of other possible inefficiency sources at all levels of performance.

Jel Classification : Q4; L94

Key words: India, electricity, cost inefficiency, commercial loss, reform.

1. Introduction

The electric utility is unique in that its product is one that cannot be stored for marketing, but must be generated the instant it is to be used. The economies of scale involved in such a technical characteristic had traditionally rendered the utility a vertically integrated industry, combining all the three functions of generation, transmission and distribution. The consequent natural monopoly position of the industry in turn had concurrently meant its state regulation or outright nationalization. Where the state held the reins of the utility, as in India and in most of other developing countries, avowed adherence to improvements in equity equations overshadowed essential economic efficiency parameters in the development and operation of this infrastructure. However, times have soon come up to frame new rhymes of perspectives. It has now been recognized that the economies of scale have already been exhausted or become irrelevant, the vertical integration can safely be 'unbundled', and that (at least) in generation, monopoly structure can effectively be mown up, and competition commissioned instead. Thus has commenced an era of reforms and restructuring of power sector across the globe. In no time have the waves of reforms, sprung and sponsored by the premier international financial agency, swept over the Indian power sector too to germinate radical results of irreversible imposition of restructuring.

Power development is placed in the concurrent list of the Indian Constitution, as a joint responsibility of both the States and the Centre. In the First Five Year Plan (FYP), 19.02 per cent of the total Plan outlay was earmarked for power development. Even though the power sector outlay has steadily increased since then in absolute terms, its percentage share fell to 8.89 per cent in the Second FYP, and then rose in the subsequent Plans to reach the all-time maximum of 20.13 per cent in the 6th FYP, only to fall again in the 7th (19.04 per cent) and 8th (18.33 per cent) Plans. The total installed capacity (IC) grew at an average annual compound growth rate of 8.65 per cent during the last four decades from 3,223.11 mega watt (MW) in 1957-58 to 89,090 MW in 1997-98. The share of hydel in total capacity plummeted to 24.6 per cent from 37.7 per cent and that of thermal (including nuclear) went up to 76.4 per cent from 62.3 per cent. Out of the total IC in 1997-98, 63.3 per cent was owned by the States, 30.7 per cent by the Centre, and 6 per cent was in the private sector. Actual generation increased during these four decades at a rate of 9.45 per cent p. a., from 11,369.14 million units (MU; 1 unit = 1 kWh) in 1957-58 to 4,20,405 MU in 1997-98, and total sales of electricity at a rate of 9.0 per cent p. a., from 9,345 MU to 2,93,479 MU respectively.

This seemingly impressive growth, however, conceals much of the innate inadequacies of the system; its deficient capacity, lagging far behind the growing demand, has plunged the country into a chronic shortage situation – with an energy deficit of 11.5 per cent and a peak load deficit of 18 per cent by the end of the 8th Plan (1996-97). Still worse, the per capita consumption of electricity in India has been one of the lowest in the world. The immediate victims of the widening load-capacity gap have been the quality and reliability of the power supplied; for example, the Kerala system operates under low voltage and low frequency (some times up to 47.5 Hz, instead of 50 Hz) to reduce load further in addition to regular power cuts and load shedding, that have become the rule of the day.

The cumulative effect of a legion of compounded forces has been at work behind this plight of shortages. For one thing, in no Plan period the target in IC could actually be achieved, the cumulative slippage between the target and the achievement remaining well over 20 per cent. Poor capacity utilization has substantially corroded the system performance. Capacity utilization in terms of energy generated per KW of IC grew over the last four decades in India at an average annual compound rate of just 0.73 per cent from 3,527.38 KWh/KW in 1957-58 (utilization of 40.27 per cent) to 4,718.9 KWh/KW (53.87 per cent) in 1997-98. Still much more dismal is the condition of capacity utilization in terms of energy sold per KW of IC – with a growth rate of only 0.32 per cent p. a., from 2,899.37 KWh/KW (33.10 per cent utilization) to 3,294.19 KWh/KW (37.61 per cent) over the same period. The growth over the last four decades of energy generated and sold indicates an elesticity of energy sales with respect to energy generated of just 0.843. This highlights high levels of auxiliary consumption and extremely high transmission and distribution (T&D) losses. Adding to these infirmities of inadequacies have been the financial failures from a host of other factors – irrational pricing practices and over-manning, sponsored by political pampering of subsidies at the cost of efficiency, and an infamously flourishing ‘X-inefficiency culture’.

The financial morbidity of the SEBs has allegedly not only decelerated capacity addition in the States, but damped down the private sector sentiments also. As the agenda notes of the recent conference of Power Ministers noted, “Fresh attempts at generation projects by Independent Power Producers (IPP) have reached a dead end with escrow capacity having been more or less exhausted in the country” (Government of India 2000: 1). The only alternative of Central sector investment too stands to suffer from the mounting receivables from the SEBs; (the SEBs owe NTPC a cumulative sum of Rs. 12428 crores – ibid.: 1). The failure in adequate additions in capacity by all the sectors thus continues, and serves as an impetus to inviting World Bank initiation into reforms.

In what follows, we attempt to look into the above aspects for a possible explanation of what in their behaviour trajectories have warranted reforms in the power sector in India in general and Kerala in particular. The references to Kerala situation in this paper arises out of a larger study intended to diagnose the problem faced by the power sector in the State. Nevertheless, our observation on Kerala apply to most other SEBs, though in varying degrees. The plan of this paper is as follows: In the next section, physical performance of the State power sector is evaluated, and the inadequacy and inefficiency[1] involved are brought out, in relation to their possible causatives. Section 3 analyses the cost structure of electricity supply in India; and cost savings realizable from some reasonable improvements in efficiency at certain accessible levels of techno-economic performance are also estimated. After a brief discussion in Section 4 on the tariff structure, we take up in Section 5 an appraisal of the financial performance of the State power sector and light up the likely implications involved in inefficiency. The final part concludes the discussion with a rather cynical note on the power sector reforms vis-à-vis the form-substance dialectics.

2. Physical Performance

Inadequate Capacity Additions

The apparently impressive growth in installed capacity at the aggregate national level, however, is not distributed evenly across regions. During the seventies, marked by pervasive enthusiasm for power development, regional disparity in the growth of IC was significantly evident; 9 States, out of the 19 considered, had a growth rate higher than the national average of 7.5 per cent p. a., and 5 States, less than 5 per cent. (Table 1). Even Kerala, which was a power surplus State during this period, was in the intermediate group of States. While power development of higher growth profile entails uneven distribution, power shortage converges growth rates to the minimum and thus ensures an equation among them, as has been evident since the eighties across the States. None of the States has had a growth rate even to touch the immediate vicinity of the national average of 6.6 per cent, all crowding in around a minimum. This also signifies the shift in the weight of capacity addition from the States to the Central sector. In fact, the share of the Central sector in the ownership of the total IC increased from 9.8 per cent in 1970-71 to 22.3 per cent in 1990-91 and then to 30.7 per cent in 1997-98, and the share of the States fell from about 80 per cent in 1970-71 to 63.3 per cent in 1997-98. Thus, with every one percentage point fall in the States' share, the Central share increased by about 11 percentage point. Indeed the Central sector IC growth rate (11.52 per cent) was about twice the States' sector one (5.97 per cent), with the former now necessarily catering to the needs of the latter.

Even then, by the end of the 8th Plan (in 1996-97), the country as a whole stood to suffer from a peak power deficit of 18 per cent, with little change over the Plan period, and from an increased energy deficit of 11.5 per cent. In 1997-98, these deficits were respectively 11.3 and 8.1 per cent. In most of the States, the situation has been on the worse. Though the Central and State governments do continue to be confident of the dream of a power surplus nation coming into reality by 2012, a time-run-out assertion, considering the present tempo of the progress in many States in the highly unconducive atmosphere complicated by political, social, and ecological issues and conducts, it just seems to be an excusable quarter for another time-run-out. Significant in this respect has been the

Table 1. Growth of Installed Capacity

	Installed Capacity (MW)			Annual Average Compound Growth Rate (%)		
	1970-71	1980-81	1997-98	1970-81	1980-98	1970-98
Andhra Pradesh	608	2240	5764.2	13.929	5.717	8.687
Assam	180	228	616.7	2.392	6.028	4.666
Bihar	499	941	1988.4	6.549	4.499	5.254
Delhi	252	276	653.6	0.914	5.202	3.593
Gujarat	907	2197	4883.2	9.250	4.810	6.433
Haryana	504	1141	1780.3	8.514	2.651	4.785
Himachal Pradesh	51	129	299.5	9.724	5.080	6.776
Jammu & Kashmir	40	206	365.8	17.810	3.435	8.542
Karnataka	878	1470	3434.5	5.289	5.119	5.182
Kerala	547	1012	1775.8	6.350	3.366	4.461
Madhya Pradesh	727	1631	3875.9	8.416	5.224	6.395
Maharashtra	2119	3992	8289.8	6.538	4.392	5.182
Meghalaya	68*	131	188.8	14.013*	2.173	4.751*
Orissa	564	923	1693.0	5.049	3.633	4.155
Punjab	680	1536	2465.1	8.490	2.822	4.886
Rajasthan	541	810	1369.8	4.119	3.139	3.501
Tamil Nadu	1966	2329	5763	1.709	5.474	4.064
Uttar Pradesh	1351	3612	6168.8	10.334	3.199	5.786
West Bengal	1212	1726	2904	3.599	3.108	3.289
Central Sector	1441	2198	27379.5	4.313	15.994	11.522
DVC	1062	1422	..			
State Departments	974	1481	..			
Local Bodies	267	276	..			
Private Sector	1488	1382	5337.0	-0.736	8.272	4.844
All India	14709	30214	89090.0	7.464	6.568	6.899

Note: * = For (with respect to) 1975-76; All India IC (1997-98) includes that for EDs, BBMB and others (Islands).

Source: For 1970-71 and 1980-81 and for Haryana, from CMIE, *Energy*, March-April, 1999; 1997-98 from Planning Commission (GOI), *Annual Report on Working of SEBs & EDs*, April1999; for Kerala, KSEB, *Power System Statistics*.

avoidable disturbing trend in the power sector investment in terms of an unwarranted bias against cheap hydro-power, the hydro-thermal mix being 1:3 by 1997-98; i.e., hydro-power accounts for only about 25 per cent of the total IC in 1997-98. This in turn implies an untapped potential of conventional hydro resources to the tune of about 74 per cent (out of the total 84,000 MW estimated at 60 per cent load factor) in the country. In the popular perception, the temptation would be to blame the organized ecological concerns farrowing the high cost thermal power[2]. We are not sure that this alone would explain the lack of enthusiasm in exploiting the hydro potential in the country.

Technical Inefficiency

Side by side with this inadequate timely capacity additions has been the inescapable long-run experience of under-utilization of the existing capacity itself in the country. An unavoidable reason for an apparent under-utilization of capacity stems from the gradual growth of power demand against the periodic burst of increase in capacity due to its indivisibility. Thus normally with every capacity addition, its utilization rate immediately dips down, as was the case in most of the States during the seventies. But in a power deficit situation, with inadequate capacity addition against an ever-increasing demand, utilization of the available capacity is necessarily expected to be higher, if not maximum. The actual experience, however, has been far from this possibility. In 1997-98 (even in the face of deficit), only 54 per cent of the existing IC in India was utilized (Table 2). As many as 11 (out of 19) SEBs had a use factor much less than this all-India average, including Kerala and Tamil Nadu in the South, and only four (as well as the Central Sector with 63 per cent) had a rate higher than 60 per cent. It should be noted that for a hydro-power dominant system, such as in Himachal Pradesh, Meghalaya, Kerala, and, to some extent now, Karnataka, utilization efficiency should be evaluated

Table 2: Growth of Energy Generation

	Energy Generated (MU)			Utilization (KWH/KW)			Utilization Rate (%)			ACGR of Generation (%)		
	1970-71	1980-81	1997-98	1970-71	1980-81	1997-98	1970-71	1980-81	1997-98	1970-81	1980-98	1970-98
Andhra Pradesh	2937	7319	27674	4830.6	3267.4	4801.0	55.14	37.30	54.81	9.56	8.14	8.66
Assam	369	465	1074	2050.0	2039.5	1741.5	23.40	23.28	19.88	2.34	5.05	4.04
Bihar	1372	2281	3666	2749.5	2424.0	1843.7	31.39	27.67	21.05	5.21	2.83	3.71
Delhi	1027	1313	2509	4075.4	4757.2	3838.7	46.52	54.31	43.82	2.49	3.88	3.36
Gujarat	4176	9363	25102	4604.2	4261.7	5140.5	52.56	48.65	58.68	8.41	5.97	6.87
Haryana	1848	4289	3773	3666.7	3759.0	2119.3	41.86	42.91	24.19	8.78	-0.75	2.68
Himachal Pradesh	62	245	1274	1215.7	1899.2	4253.8	13.88	21.68	48.56	14.73	10.18	11.85
Jammu & Kashmir	168	768	976	4200.0	3728.2	2668.1	47.95	42.56	30.46	16.41	1.42	6.73
Karnataka	4754	6392	17032	5414.6	4348.3	4959.1	61.81	49.64	56.61	3.00	5.93	4.84
Kerala	2126	5242	5188.7	3890.2	5182.0	2921.9	44.41	59.16	33.36	9.44	-0.06	3.36
Madhya Pradesh	2754	5952	20125	3788.2	3649.3	5192.3	43.24	41.66	59.27	8.01	7.43	7.64
Maharashtra	9134	17664	41466	4310.5	4424.8	5002.1	49.21	50.51	57.10	6.82	5.15	5.76
Meghalaya	181*	353	597	2661.8*	2694.7	3162.1	30.39*	30.76	36.10	14.29*	3.14	5.57*
Orissa	1766	3137	5729	3131.2	3398.7	3383.9	35.74	38.80	38.63	5.91	3.61	4.45
Punjab	2365	6483	13007	3477.9	4220.7	5276.5	39.70	48.18	60.23	10.61	4.18	6.52
Rajasthan	1509	3393	7694	2789.3	4188.9	5616.9	31.84	47.82	64.12	8.44	4.93	6.22
Tamil Nadu	5638	7372	23079	2867.8	3165.3	4004.7	32.74	36.13	45.72	2.72	6.94	5.36
Uttar Pradesh	5725	10190	23690	4237.6	2821.2	3840.3	48.37	32.20	43.84	5.94	5.09	5.40
West Bengal	4056	5563	10540	3346.5	3223.1	3629.5	38.20	36.79	41.43	3.21	3.83	3.60
Central Sector	5399	8450	151189	3746.7	3844.4	5522.0	42.77	43.89	63.04	4.58	18.49	13.14
All India	55828	110844	420405	3795.5	3668.7	4718.9	43.33	41.88	53.87	7.10	8.16	7.76

Note: * = For (with respect to) 1975-76; ACGR = Annual Average Compound Growth Rate.
Source: As in Table 1.

with respect to firm power capacity (the always available and dependable capacity corresponding to the minimum stream flow and storage) rather than with respect to IC. Thus taking into account the hydel firm power capacity of 714.5 MW of Kerala in 1997-98, the actual capacity utilization comes out to be 6,308.46 KWh/KW or about 72 per cent. However, a distressing question here concerns about the wide gap of 'waste' between the IC and the dependable power of the hydro-plants; the latter being just 42.3 per cent of the hydel IC in Kerala in 1997-98. Considerable timely efforts on firm power augmentation projects are called for here, besides those on the usual IC additions.

One important causative factor of such low capacity utilization is the poor technical efficiency, reinforced by an inability to attain and assimilate significant technological progress over time. Technical efficiency in generation in general is determined by plant availability (which in turn is determined by forced outages), by plant load factor (PLF), as also by auxiliary consumption. Forced outages occur when a unit is thrown out of service due to unexpected causes such as breakdown, equipment malfunction, etc., and are usually of a random nature. These outages generally befall on the operation side in generators, boilers, turbines, and their auxiliaries. There are also electrical and mechanical forced outages, due to poor quality of fuel, wet coal being supplied, and lack of timely and proper maintenance practices that cause Grid system faults, which are always avoidable. Units are also shut down at times for planned preventive maintenance, intended to ensure their proper running conditions, and also due to lack of adequate system load and of water in reservoir in the case of hydro plants. Considerations of plant availability factor and PLF are usually associated with analyses of technical efficiency only of thermal power plants. Hydro plants are generally expected to be much less prone to forced outages than thermal plants, and their availability is expected to be open always and at maximum subject to firm power capacity constraints. However, the hydro plants in Kerala stand an exception to this expected rule, and also smart for higher forced outage rates (FORs) and loss of load probability (Pillai 1991, 1999). The FORs of the hydro system in Kerala (41 units of 11 plants) on an average were as high as 17.71, 22.59, and 13.12 per cent respectively for the three years of 1982-83 to 1984-85. In 1996-97, it was 8.96 per cent, while the all-India average for thermal plants was 12.8 per cent. The planned maintenance rate of the hydro-power system in Kerala on an average was 12.88 per cent in the same year, and the reserve shut down rate, 11.87 per cent, the latter being largely due to lack of water in storage. The thermal systems of the other Southern States had much lower FORs. Bihar, Assam, Uttar Pradesh, Haryana, and Orissa (till 1994-95) are some of the States with very high FORs and hence much lower availability of capacity (Table 3).

The availability factor is defined as unity less planned maintenance rate (PMR) less forced outage rate (FOR); i.e., availability = 1 – (PMR + FOR).[3] In 1997-98, the availability of thermal plants in India in general was nearly 80 per cent, with 8 SEBs having availability higher than this average, including all the three neighbours of Kerala in the South, Andhra Pradesh being the topper (since 1995-96 onwards). The availability of the Kerala hydro-power system is estimated at 78.16 per cent only for 1996-97, reflecting the undesirably higher extent of outages. Bihar's has been the worst affected SEB for a long time in this respect; Assam follows suit. Delhi, Haryana, Uttar Pradesh, and West Bengal are all in the red (Table 3).

Load factor is generally defined as the ratio of average load to maximum (or peak) load. More exactly, it is also defined as the ratio of energy consumed (average load) in a given period to energy which would have been consumed, had the maximum demand been maintained throughout that period. Extended thus to a generating unit, plant load factor (PLF) then refers to the ratio of the actual generation of that plant to its maximum possible generation during a period (one year). Remember that even if the plant is available with a high probability, it may have at times to be backed down due to lack of adequate system load (reserve shut down), and hence the actual generation of the plant may fall short of availability. PLF is then defined in this vein also as availability less reserve shut down rate. Thus the difference between availability and PLF represents a safety margin, buffer, or reserve margin, with a demand- cushioning effect. A PLF very close to availability might be misconstrued as reflecting better capacity utilization; such over-exertion, however,would definitely tell upon the life of the plant, and increase its ‘down’ chances. Hence, along with a higher availability, an adequately high reserve margin also is desirably sought for. PLF also is influenced by factors like age of the generating plant, quality of coal, and its timely and adequate availability, shortcomings in energy evacuation, and equipment deficiencies.

While the plant availability remained about 75 to 79 per cent in the 8th Plan period, the average PLF of the thermal plants had a distinct improvement from 55.3 per cent in 1991-92 to 64.7 per cent in 1997-98. In that year, the PLF in the Central sector was nearly 71 per cent, and in the Private sector, 71.1 per cent, while the all-SEBs average was only 60.9 per cent, ranging from 16.1 per cent of Bihar to 82 per cent of Andhra Pradesh. Of the other two neighbours of Kerala, Karnataka had a PLF of 75.2 per cent and Tamil Nadu, 68.1 per cent. Kerala hydro-power system had an estimated PLF of 66.29 per cent in 1996-97. When compared with availability, most of these rates are satisfactorily tolerable, revealing at the same time the outages that affect availability as the important culprit in low levels of capacity utilization in India. It should also be pointed out that the power plants in the State sector are in general

Table 3: Some of the Technical Performance Indicators

State	Forced Outage Rate (%)			Load Factor (%)			Auxiliary Consumption (%)		
	1991-92	1997-98	ACGR (%)	1991-92	1997-98	ACGR (%)	1992-93	1997-98	ACGR (%)
Andhra Pradesh	11.28	4.30	-14.85	62.1	82.0	4.74	5.36	6.53	4.03
Assam	34.39	48.50	5.90	24.6	21.3	-2.37	9.81	7.84	-4.38
Bihar	27.57	48.30	9.80	21.3	16.1	-4.56	12.87	14.00	1.70
Delhi (DESU)	16.50	19.08	3.09	57.2	47.2	-3.15	8.44	8.26	-0.43
Gujarat	10.62	7.80	-5.01	56.9	65.6	2.40	10.39	9.47	-1.84
Haryana	30.94	22.70	-5.03	45.8	49.4	1.27	5.33	6.00	2.40
Himachal Pradesh	:	:	:	:	:	:	0.35	0.48	6.52
Jammu & Kashmir	:	:	:	:	:	:	1.00	1.00	0.00
Karnataka	8.81	5.30	-8.12	59.1	75.2	4.10	0.12	1.82	72.26
Kerala	4.19	8.96*	16.42*	73.6	66.3*	-1.73*	0.50	0.61	4.06
Madhya Pradesh	16.51	10.40	-7.41	49.2	66.0	5.02	9.26	8.63	-1.40
Maharashtra	13.67	9.40	-6.05	61.3	68.3	1.82	7.91	7.38	-1.38
Meghalaya	:	:	:	:	:	:	0.42	0.34	-4.14
Orissa	26.98	5.20	-24.00	30.0	65.3	13.84	2.89	10.52	29.49
Punjab	7.07	4.70	-6.58	52.8	69.1	4.59	4.20	4.97	3.42
Rajasthan	14.82	5.00	-16.56	65.7	80.5	3.44	7.33	7.47	0.38
Tamil Nadu	13.80	8.20	-8.31	55.7	68.1	3.41	6.06	7.24	3.62
Utter Pradesh	27.67	23.20	-2.89	44.3	48.8	1.63	8.74	7.18	-3.86
West Bengal	13.90	22.00	7.95	30.8	40.0	4.45	11.14	10.8	-0.62
Central Sector	13.50	10.60	-3.95	64.5	70.4	1.47			
Private Sector	8.60	2.90	-16.57	64.5	71.1	1.64			
All India	15.19	12.10	-3.72	55.3	64.7	2.65	6.91	7.06	0.43

Note: * = for (with respect to) 1996-97; ACGR = Annual Average Compound Growth Rate (%).

Sources: Planning Commission, (GOI), April 1999; Kerala's forced outage rates and load factors are estimated from KSEB, *System Operations* and *Power System Statistics* (various years) respectively.

much older than in the Central or Private sector, and the state of maintenance of these units also remains very poor[4]. A significant determinant of the higher PLF in the Central sector has been an increasing share, in their total IC, (now about 75 per cent) of 500 – 200 MW capacity plants, with fluidized bed boiler (FBB) designs suited to the Indian coal quality, whereas in the State sector such larger capacity plants constitute less than 60 per cent of the total IC only. Plants of lower capacity (120 MW and below), with an inappropriate boiler design (Czech), that cannot handle Indian coal of high ash content, make up only 20 per cent of the total IC in the Central sector, but as much as about 40 per cent in the State sector, out of which almost 16 per cent make up plants with less than 90 MW capacity (Table 4). In fact, there have been attempts that attribute the increasing trend in the PLF in the Indian power sector in general since the eighties to the introduction of larger capacity plants – 200 MW introduced in the late seventies, and 500 MW in the mid-eighties[5]. Some cases, however, invalidate this 'size matters' claim – for example, in Punjab, Maharashtra, Karnataka and Tamil Nadu (in the early nineties in the last two cases), where larger capacity plants (more than 200 MW) predominate, the PLF trend was not satisfactory, whereas Andhra Pradesh fared far better with much lower share of larger plants than others[6]. This reveals some still untapped quarters of improvement available in many States. Side by side with the introduction of new vintage plants of higher technical efficiency, proper and timely maintenance of plants to ensure their healthy life also is indispensable. It has been recognized that in many cases investments in long term rehabilitation and re-powering of old plants fructify more promisingly than in installing new generation capacity.

In addition to this technical inefficiency in energy generation is the higher level of auxiliary consumption at generation end that eats into

Table 4: Capacity-wise Distribution of Thermal Plants - 1994-95

	Percentage Distribution of Plants by MW Size						
	> 200 - 210	140 - 150	115 - 120	105 – 110	90 - 110	< 90	Total
Andhra Pradesh	59.1	0	0	20.7	0	20.2	100
Assam	0	0	0	0	0	100	100
Bihar	0	0	0	66.2	7.7	26.1	100
Gujarat	57.8	7.1	18.2	0	0	16.9	100
Haryana	25.2	0	0	52.8	0	22	100
Jammu & Kashmir	0	0	0	0	0	100	100
Karnataka	83.1	0	0	0	0	16.9	100
Madhya Pradesh	66.5	0	15.3	0	0	18.2	100
Maharashtra	72.4	4.4	9.5	6.9	0	6.8	100
Orissa	0	0	0	46.8	0	53.2	100
Punjab	74.1	0	0	25.9	0	0	100
Rajasthan	74.1	0	0	25.9	0	0	100
Tamil Nadu	79.9	0	0	14	0	6.1	100
Uttar Pradesh	52.3	0	0	21.6	7.4	18.7	100
West Bengal	60.7	0	19.8	0	0	19.5	100
All SEBs	59.2	1.8	7.3	13.8	1.6	16.3	100
Electricity Depts.	0	0	0	10.5	0	89.5	100
Central Sector	74.5	5.2	8.2	3.4	4.1	4.6	100
Private Sector	38.4	5.5	4.4	10.6	0	41.1	100
Total	62.4	3.2	7.4	9.8	2.4	14.8	100

Source: Rao et al. (1998-99), Table 6.

the energy available for transmission. Auxiliary consumption in the power station depends upon its layout, operation conditions, automisation, and design of various equipment. Though taken to be of the order of 3 to 5 per cent in a modern thermal plant and 0.5 per cent in a hydro plant, auxiliary consumption in India has been nearly 10 per cent over the years. Reported as a weighted average of thermal and hydel plants in the State sector, it remained in the range of around 7 per cent in the 8th Plan period. Bihar, Orissa, and West Bengal have had always much higher auxiliary consumption – more than 10 per cent (Table 3). In Kerala, the trend in auxiliary consumption has of late been on the rise, away from the erstwhile satisfactory plane; it is expected to be so, as more and more thermal plants come into operation.

T & D Losses

The energy sent out, net of auxiliary consumption, then fritters away in transmission and distribution (T & D) network[7] to such a substantial extent that by the time it reaches the sales point, it would often be only a smaller fraction of the net generation. Over 82 billion units of electricity were lost in T & D in various States in India in 1997-98. The losses increased from 19.8 per cent in 1992-93 to 23 per cent in 1996-97, and then declined marginally to 21.8 per cent in the next year (Table 5). These are very high by international standards – compared with less than 10 per cent in most of the developed economies and with less than 15 per cent in many developing countries such as China (7 per cent), Thailand (10 per cent), Argentina (12 per cent), and Chile (11 per cent) (Rao, et al. 1998-99: 42). In almost all the States the losses remain very high, from 15.2 per cent in Maharashtra to 47.5 per cent in Jammu & Kashmir in 1997-98. Delhi stands next to Jammu & Kashmir with 43 per cent; then Orissa (39 per cent), Haryana (32.2 per cent), Andhra Pradesh (25 per cent), Assam (24 per cent), Bihar, Uttar Pradesh, and

Rajasthan (23 per cent each). T & D losses in Kerala was in a satisfactorily comparable position till some two decades back, the losses having been less than 15 per cent. However, it increased to substantial extent in the following years, averaging about 24 per cent during 1982-83 to 1996-97. In 1997-98, it was 17.87 per cent, while for Andhra Pradesh, it was 25 per cent, for Karnataka, 18.4 per cent, and for Tamil Nadu, 17 per cent.

The neglect of the T & D sector, especially the transmission sector, in terms of adequate investments in capacity and maintenance, and the lack of systematic T & D planning over the years are the major technical factors contributing to the high level of T & D losses. Defective metering, unmetered supply and pilferage are the main non-technical factors. There has been over the years a pronounced bias in investment in favour of augmenting generation capacity to the utter neglect of the 1:1 norm in investment in generation and T & D sectors. Despite the increased funds allocation given to T & D sector in the recent past, out of the belated recognition of the compounded effects of neglect, under-utilization or diversion of funds (meant especially for transmission capacity augmentation) into generation and/or distribution sector still plagues the system. Increase in demand by an increasing number of consumers vis-à-vis inadequate T & D capacity has resulted in heavy overload on the system, causing substantial line losses. During the period 1970-71 to 1996-97, the number of consumers increased by 7.26 per cent per annum, and IC, though restricted, by about 7 per cent, while the annual growth in transmission lines was 4.55 per cent and distribution (low tension, LT) lines, 6.15 per cent. The ratio of the length of transmission lines to the length of distribution lines dropped from 7.73 per cent in 1970-71 to 5.2 per cent in 1996-97; in 1990-91, it was only 4.78 per cent. Evidently, the imbalance between the two has been on the rise, worsening the overload problem. Where domestic load is more spread out, as in Kerala, large-capacity distribution transformers demand large lengths of LT line, resulting in increased line losses. Larger number of small transformers is more desirable in such situations; this is possible only with substantial increase in 11 kV (or above) lines. However, the 11 kV lines to LT lines ratio which was about 1:1 in 1951 in Kerala, for example, has now fallen to 1:5 (in 1997-98). The ratio of the length of 15/11 kV lines to that of LT lines was 1:2 in 1996-97 in India. At the same time, transformation losses are higher for small-capacity transformers; in a 200 kVA transformer, it has been found, iron loss is 0.28 per cent, and copper loss is 1.67 per cent, while in a 25 kVA transformer, the losses are respectively 0.75 per cent and 3.5 per cent (Shah, Dalal, and Patel 1985). Three-phase lines instead of the common one-phase line would also reduce the T & D loss considerably (by more than one-sixth). The nominal transmission (extra high voltage, EHV) lines in vogue in India are of high-voltage direct current (HVDC), 400 kV, 230/220 kV, 110 kV, and 66 kV. HVDC lines have been so far introduced by the Andhra Pradesh SEB (37 circuit km.) and the Central sector in Northern region (1630 ckt. km.) only, and 400 kV lines by the SEBs of Punjab, Uttat Pradesh, West Bengal, Madhya Pradesh, Maharashtra, Gujarat, Karnataka, Bihar, and Orissa, besides the Central Sector. The low voltage 132/110/90 kV lines predominate the transmission sector in the proportion of 400 kV : 230/220 kV : 132/110/90 kV = 0.36 : 0.81: 1 (as in 1996-97). Similarly, the low tension (LT) distribution lines predominate over the high voltage ones in the proportion of 33/22 kV : 15/11 kV : 6.6/3.3/2.2 kV : LT = 0.077:0.49:0.0015:1. The proportion of LT lines to EHV lines is just 1 : 0.07. In Kerala, the proportion of 220 kV : 110 kV : 66kV : 11 kV : LT in 1997-98 was 0.013 : 0.019 : 0.0195 : 0.195 : 1, and the proportion of LT lines to EHV lines was 1 : 0.032, more than double the all-India average. Since a predominantly low voltage network characterizes the Indian power sector in general, higher technical line losses and poor quality of electricity at user ends are an inescapable fact. In fact, the low-voltage-low-frequency profile common in many States is an easy option of escape route for mitigating the power deficit, which would get aggravated with any attempt to raise the voltage level in the basic system without adequate additions to generating capacity. In this respect, the tie up of a State Grid with a Regional Grid that operates at low system frequency due to overload further reduces quality. For example, the Southern Grid, with which Kerala system is tied up, runs at a low frequency up to even 47.5 Hz instead of the normal 50 Hz. The low voltage conditions in turn lead to the use of step-up transformers or voltage stabilizers by consumers, which in turn induces high inductive load and further worsens the conditions.

Even the SEBs that report lower losses (e.g., Maharashtra) have to improve further to attain standards of efficient systems abroad; yet a large potential for energy and capacity savings is available if all SEBs could bring losses down at least to these levels e.g., of Maharashtra). Let us assume such a situation – that T & D losses are only 15 per cent of the energy available in India. Then in 1997-98, the losses would be only 59,443.13 MU, instead of the actual 82,462.9 MU, giving a potential saving in energy of 23,019.78 MU and in revenue of Rs. 42,466.88 million, at an average rate of Rs. 1.845 per unit. This brings out the immense cost of the avoidable inefficiency in the Indian T & D sector – a revenue loss of around Rs. 4,000 crores every year ! Moreover, the energy thus lost in excess of the notional 15 per cent in fact represents a generating capacity of about 4,380 MW at 60 per cent load factor. It means that if the T & D system in India could maintain the energy loss at least at 15 per cent per annum, it could then help dispense with the need for adding about 4,000 MW to the installed capacity, saving immensely in investment and working capital costs. That these savings were in addition to the potential increase in sales revenue by around Rs. 4,000

Table 5: T & D Loss as Percentage of Electricity Available

					ACGR (%)	Theft / Misuse Cases (1996-97)	
	1970-71	1980-81	1990-91	1997-98	1970-98	Number	Loss (MU)
Andhra Pradesh	25.42	22.6	22.4	25.0	-0.06	25681	61.81
Arunachal Pradesh	NA	24.0	20.0	30.0	1.32*	..	..
Assam	17.68	19.3	24.1	24.0	1.14	579	NF
Bihar	22.85	22.1	21.1	23.0	0.02	675	0.38
Delhi (DVB)	11.07	18.4	24.9	43.0	5.15	NF	NF
Goa	18.09	25.7	25.0	26.0	1.35	..	..
Gujarat	14.52	19.8	23.7	18.0	0.80	46241	0.02
Haryana	27.94	22.6	27.5	32.2	0.53	NF	NF
Himachal Pradesh	12.23	19.3	21.5	17.4	1.31	1529	0.13
Jammu & Kashmir	21.66	48.1	42.3	47.5	2.95	NF	NF
Karnataka	14.62	24.6	20.1	18.4	0.86	184	3.00
Kerala	12.80	14.2	21.6	17.9	1.24	1813	3.34
Madhya Pradesh	14.69	22.3	24.9	19.0	0.96	245185	150.68
Maharashtra	13.67	16.2	18.1	15.2	0.39	6142	42.35
Manipur	NA	55.6	28.0	21.5	(-)5.44*	..	..
Meghalaya	NA	9.1	11.8	16.9	3.71*	654	0.72

(Table 5 contd........)

(Table 5 continued......)

					ACGR (%)	Theft / Misuse Cases (1996-97)	
	1970	1980-81	1990-91	1997-98	1970-98	Number	Loss (MU)
Mizoram	NA	22.2	29.6	26.0	0.93*	..	..
Nagaland	NA	23.1	26.1	29.0	1.35*	..	..
Orissa	6.15	19.2	25.3	39.0	7.08	845	3.16
Punjab	22.38	19.6	19.0	18.0	(-)0.80	70924	217.41
Rajasthan	13.11	26.6	25.9	23.0	2.10	53218	113.99
Sikkim	NA	22.9	24.5	20.0	(-)0.79*	..	..
Tamil Nadu	17.67	19.1	18.7	17.0	-0.14	774	NF
Tripura	NA	31.5	29.6	29.8	(-)0.33*	..	..
Uttar Pradesh	24.49	15.6	26.9	23.0	-0.23	NF	NF
West Bengal	10.18	13.7	21.8	19.7	2.48	8249	17.72
All India	17.55	20.6	22.9	21.8	0.81	462693	614.71

Note: * = with respect to 1980-81; NF = Not Furnished (to CEA).

Source:1970-71, 1980-81 and 1990-91, CMIE, *Energy*, March - April 1999, and *Basic Statistics Relating to the Indian Economy*, (different volumes); 1997-98 and 1998-99 from Planning Commission (GOI), April, 1999;

for Kerala, KSEB, *Power System Statistics;* last two columns, from CEA, *Public Electricity Supply, General Review,* 1996-97.

crores per year speaks volumes for the gravity of the problem. Now just reflect upon a drop in T & D losses to the ideal 10 per cent norm. It must, however, be noted here that the non-technical energy losses due to theft, etc., cannot be converted into energy and capacity savings, but can only be included in revenue savings. Though theft of electricity has been made a cognizable offence since 1986 under the Indian Electricity Act, 1910[8], this has had no effect on the theft problem. Some of the SEBs are reported to conduct checks and detect cases of theft or misuse of electricity. Some estimates of energy lost in pilferage/misuse are also available – e.g., in Karnataka, as much as 16.3 thousand units of electricity are estimated to have lost per case of theft/misuse detected in 1996-97, and in Gujarat, only 0.43 units per case detected. In Kerala, the loss was estimated at 1,842.3 units per case detected, in Maharashtra, as much as 6,895.1 units per case, and in Punjab, 3,065.4 units per case (Table 5). On an average, in 1996-97, an estimated quantum of about 1,332 units of electricity was lost per case of theft/misuse detected in 13 States. Though under-estimates, these figures do represent a big drain on the SEBs' revenue stream. The estimated revenue loss for the 13 States in 1996-97 in this respect amounted to Rs. 100.19 crores at an average rate of Rs. 1.63/unit, and for Punjab alone, Rs. 29.63 crores, at Rs. 1.36/unit. Data are unavailable/withheld on the estimates of energy loss in theft in some SEBs, where in fact pilferage is a major problem, for example, Delhi, with no rural electrification commitment that involves high T & D loss.

T & D Losses – An Underestimate

There is little doubt that even these high figures of T & D losses are only underestimates that find a suitable cover-up in the overestimates of agricultural consumption. In most of the States, agricultural consumption is largely unmetered, and the SEBs, in their eager to record reduced transit losses, find this situation a convenient 'dump' for a good part of the unaccounted-for energy. We can have a rough estimate of such diversion. The energy consumption per energized pump-set in the agricultural sector, (that accounts for about 30 per cent of total electricity consumption), of India in 1997-98 was 7,492.4 units. In Tamil Nadu, where most of the agricultural consumption, accounting for about 27 per cent of total consumption, is metered, consumption per energized pump-set in that year was only 4,471.05 units. In 1996-97, average electricity consumption per energized pump-set in India was 7,264.72 units and in Tamil Nadu, 4,425.46 units per set. It may not be unreasonable then to assume that the power consumption in general in the agricultural sector in India is around 4,000 – 4,500 units per energized pump-set. This in turn implies that about 40 per cent of what is branded as agricultural consumption, estimated as a residual after setting the target for T & D loss (reduction), accounts for unaccounted-for energy. The estimate is of course, a rough one, as it ignores the differences in capacity, efficiency, and duration of use of the pump-sets on the farm across the country: still it drives home the essential point of the cover-up. Comparing energy consumption per kW of connected load (CL) in the agricultural sector would be a better method, though it too suffers from the problems of differences in efficiency and duration of use, etc. We have, however, tried out that also. The average electricity consumption per kW of CL in the agricultural sector in India in 1996-97 was 1,866.36 units/kW, and that in Tamil Nadu, 1,287.2 units/kW, indicating that, by this definition, a little over 30 per cent of what is reported as agricultural consumption in India represents unaccounted-for energy. If we consider consumption per agricultural consumer, it was 7,444.21 units in India in 1996-97, and 4,711.71 units in Tamil Nadu, showing that about 37 per cent of the reported agricultural consumption in India must be included in the unaccounted-for energy category. Thus there is no gainsaying the fact that the so-called agricultural consumption in India is an over-estimate by as much as 30 to 40 per cent – an easy cover up of the large quantum of energy losses. The actual T & D loss in India inclusive of this then amounts to about 31 to 29 per cent, instead of the reported 21.8 per cent in 1997-98. Now, considering an actual 30 per cent T & D loss (including unaccounted for energy) and proceeding with the assumption of the Indian power supply system attaining a standard level of 15 per cent loss only, we find, in 1997-98, a potential saving in energy to the tune of 59,443 MU and in revenue of Rs. 10,966 crores at an average rate of Rs. 1.85 per unit. The potential energy saving represents a generating capacity of nearly 11,310 MW at 60 per cent load factor. So much is the cost of inefficiency in one aspect (T & D) of the electricity supply in India !

Power Purchase

A good part of the net generation, itself falling short of demand, thus being lost in transit, power purchase from other States and Central sector perforce increases more than is required otherwise. In 1997-98, energy import by SEBs ranged from 16.5 per cent of the total energy sales in Meghalaya to as much as 164 per cent in Orissa. Bihar (109 per cent), Karnataka (116 per cent), Delhi (147.5 per cent), Jammu & Kashmir (156.5 per cent), West Bengal (89 per cent) and Assam (79 per cent) were the other major importers (Table 6). The appalling situation of having to resort to energy purchase much in excess of cent per cent, as in the case of the above five SEBs, means that their auxiliary consumption and other losses of energy far exceeded their own generation to cut down even the costly purchase itself. For an instance, in the case of Delhi in 1997-98, total energy sold was only 67.8 per cent of the energy imported; in other words, about 32 per cent of the energy purchased plus the whole of its own generation were lost ! In the same year in Orissa, total energy sales were only 61 per cent of the energy purchase, and the losses, the whole generation plus 39 per cent of the purchase ! Other (14) States were able to convert in varying degrees their own generation into sales revenue; in West Bengal, only 10.2 per cent of the energy generated went into sales stream (plus the whole purchase, the remaining having been lost); and in Meghalaya, as much as 76.5 per cent, in 1997-98. Kerala had to import about 55 per cent of energy needed to meet her consumers' demand, in addition to about 67 per cent of her own generation in that year. That also means about 33 per cent of energy generated was lost in auxiliary consumption and in transit.

Energy Consumption

Thus the Indian power sector, characterized by inadequate capacity, its under-utilization, and high level of losses, remains poor in its supply. Being one of the world's lowest, per capita consumption of electricity in India was only 283 units in 1993 as against 2,761 units of Venezuela, 1,627 units of Chile, 1,479 units of Uruguay, 1,463 units of Brazil, 1,438 units of Argentina, and 1,072 units of Mexico (Council of Power Utilities 1997). In 1996-97, it just reached 338 units, with the Western region having the maximum of 521 units and the North eastern region, the lowest, 107 units. In the Southern region, Kerala has always had the lowest per capita consumption, always lower than the all-India average also. One of the reasons for this , besides the restricted energy supply, is the high density of population per sq. Km. in Kerala, which is more than double of all-India average. The same low level profile is seen for Kerala in terms of electricity consumption per connected consumer also – it was only 1.41 thousand units in 1996-97 as against the Southern region average of 2.09 thousand units and the all-India average of 2.95 thousand units. Bihar enjoyed the highest average consumption level per consumer of 5.4 thousand units and Nagaland had to be contented with only 1.04 thousand units. India stand poor in terms of the average connected load

(CL) also, with only 1.97 kW per consumer in 1996-97. While as many as 11 States had higher average CL than the all-India average, no State in the Southern region came closer to this, with Kerala having only 1.23 kW of CL per consumer .

A significant change over time in the composition of electricity consumption by customer categories is discernible in almost all the States in terms of increasing share in total consumption of the domestic and agricultural consumers at the cost of industrial as also commercial consumers. At the all-India level, share of the domestic sector increased from 10.8 per cent in 1970-71 to 18.4 per cent in 1998-99, and of the agriculture from about 10 per cent to 30 per cent during the same period, whereas the share of the industry dropped from 61.6 per cent to 33.7 per cent and of the commercial sector from 7.2 per cent to about 5 per cent during this period. Kerala witnessed the most dramatic behaviour in these trends – an 11-fold increase in the share of domestic sector to account for nearly 50 per cent of the total electricity consumption in the State, and a 50 per cent fall in that of industry to account for about 33 per cent of total consumption. No other State in India (barring Manipur and Tripura) has such a domestic-sector-dominant composition of power consumption. Kerala also is one among the very few States (Orissa, Uttar Pradesh, and West Bengal) where the commercial sector prospered to some extent. In most of the other States, agriculture and/or industry account for the major share in total power consumption (Table 7), with agriculture enjoying the highest share in total consumption, with an average of nearly 40 per cent, in Andhra Pradesh, Gujarat, Haryana, Karnataka, Madhya Pradesh, and Uttar Pradesh. However, the increase in the share of agricultural consumption should be taken with a pinch of salt, since in most of the States, as already explained, it just represents the residual, that remains after accounting for all other sectors' consumption and the 'targeted' losses. That the increase in the share of

Table 6: Growth of Energy Sales

	Energy Sold (MU)			Share of Energy Purchased in Energy Sold (%)			Share of Own Energy Sold in Energy Generated (%)			ACGR of Sales (%)	ACGR of Purchase (%)	ACGR of Own Energy Sold (%)
	1970-71	1980-81	1997-98	1970-71	1980-81	1997-98	1970-71	1980-81	1997-98	1970-98	1970-98	1970-98
Andhra Pradesh	2195	5223	26831	42.96	12.81	41.95	42.63	62.22	56.49	9.69	9.60	9.77
Assam	298	640	2204	0	259.22	78.81	46.61	-219.14	43.48	7.69	12.67#	1.68
Bihar	1886	4103	7510	65.16	72.24	108.69	47.89	49.93	-17.80	5.25	7.26	(-)
Delhi	1157	2308	8495	83.41	95.84	147.51	18.70	7.31	-160.86	7.66	9.96	(-)
Gujarat	3326	7573	29515	34.67	12.43	48.23	52.04	70.83	60.87	8.42	9.76	7.49
Haryana	939	2793	9050	132.27	99.21	70.06	-16.40	0.51	71.81	8.75	6.22	(+)
Himachal Pradesh	165	433	2897	77.58	66.97	69.52	59.68	58.37	69.31	11.20	10.75	12.47
Jammu & Kashmir	170	515	2897	31.18	43.69	156.45	69.64	37.76	-98.16	10.41	17.21	(-)
Karnataka	4052	5575	16814	1.78	19.52	115.87	83.72	70.20	-15.66	5.41	23.05	(-)
Kerala	1859	4499	7716	1.13	0.97	54.91	86.44	85.00	67.05	5.41	21.29	2.39
Madhya Pradesh	2328	4583	24234	50.00	44.25	52.88	42.27	42.93	56.74	9.06	9.29	8.83
Maharashtra	7660	14399	46260	16.41	6.59	32.33	70.10	76.14	75.50	6.89	9.61	6.05
Meghalaya	162	318	547	0	0	16.47	89.50	90.08	76.53	4.61	24.91*	3.92
Orissa	1617	2624	6684	16.64	16.39	163.93	76.33	69.94	-74.59	5.40	14.72	(-)
Punjab	2192	5197	18342	120.48	85.59	31.76	-18.99	11.55	71.90	8.19	2.97	(+)
Rajasthan	982	3002	15053	111.71	135.11	64.47	-7.62	-31.06	69.51	10.64	8.41	(+)
Tamil Nadu	5261	8881	26569	20.47	44.07	38.62	74.21	67.38	70.66	6.18	8.71	5.17
Uttar Pradesh	4509	8142	28829	13.13	4.20	49.60	68.42	76.55	61.33	7.11	12.52	4.97
West Bengal	4228	5747	9790	23.18	28.87	89.02	80.08	73.49	10.20	3.16	8.43	-4.01
All India	43724	82409	293479							7.04		

Note: * = with respect to 1984-85; # = with respect to 1975-76 ACGR = Annual Average Compound Growth Rate; Own Energy Sold = Sales – Purchase.

Source: As in Table 1.

the agricultural consumption in Tamil Nadu, where it is mostly metered, was from 24.8 per cent in 1970-71 to just 27 per cent in 1998-99 does in fact lend enough strength to this contention. Moreover, the very high T & D loss percentage reported, for example, for Delhi, where agricultural consumption is very minimal and thus offers no convenient 'dump' for unaccounted-for energy, also supports our argument[9].

In addition to this low level of electricity consumption (even per customer), electricity supply industry in India is characterized by low level of accessibility – by 1991 Census, only about 42 per cent of the households in India had electricity facility, with wide rural (38.5 per cent) – urban (75.8 per cent) disparity. The lowest accessibility was in Bihar, with only 12.6 per cent of the households having been electrified and as many as 94 per cent of the rural households remaining unelectrified (Table 8). In Kerala, the percentage of households electrified, according to 1991 Census, was only 48 per cent, even though she achieved the target of cent per cent village electrification long back (in May 1979). However, as per a recent survey (Zachariah, et al. 1999: 198), conducted in 1998, 74 per cent of the households have electricity facility in Kerala. This explains partly the rapid increase in the share of domestic consumption in Kerala. The Prasad Working Group on Energy, appointed by the Government of India (1979) opined long back that village electrification is very deceptive as an index of rural electrification. That in many States, electricity still remains inaccessible to more than 20 to 25 per cent of the urban households, even though the cost of providing connection in the urban areas is minimal, is a pointer to the sluggish growth of this industry.

Institutional and Organizational Inefficiency

Besides these taut constraints upon the technical efficiency of the power sector in India are the institutional and organizational factors.

Though the Electricity (Supply) Act, 1948, requires the SEBs to function as an autonomous corporation, their actual position is as good as that of a State government department. Excessive interference in the affairs of the SEBs by the State governments, in their careerist pursuit of patronizing the social security concerns, has resulted, for one example, in over-employment in the SEBs, especially and more unwarrentedly, in administration section. The number of employees per MU of energy sold in India in 1990-91 was about 5 (implying a labour productivity of 0.2 MU per employee), while it was 0.2 (or 5 MU per employee or 25 times higher than that in India) in Chile, Norway, and USA, about 0.6 (or 1.7 MU per employee) in New Zealand, Argentina, and UK, and less than 2.5 (or 0.4 MU per employee) in some developing countries such as China, Philippines, and Indonesia (Rao et al. 1998-99: 42-43). Though the ratio declined marginally to 3.6 in 1996-97, still higher than the standards abroad, wide disparity prevails across the States, from 41.4 in Arunachal Pradesh to 1.9 in Gujarat (Table 9). Kerala had a ratio (3.8) somewhat corresponding to the all-India average, and slightly higher than her neighbours. The States like Andhra Pradesh, Maharashtra, Madhya Pradesh, etc., where there is a significant component of thermal generation, which entails substantially more manpower than required for hydro-generation, had higher labour productivity than Kerala with a pure hydro system. The over-manning problem is acute in the Special Category States of Jammu & Kashmir, Himachal Pradesh, and the North-Eastern States. Number of employees per thousand consumers in India was 13.3 in 1992-93, which dropped to 11.2 in 1996-97. Kerala had the lowest ratio during all these years with 6.1 in 1992-93 and 5.5 in 1996-97. Karnataka with 5.9 in 1996-97 stood next to Kerala. Arunachal Pradesh had the highest ratio in this respect also, with all other Special Category States having higher ratios.

Table 7: Sector-wise Consumption of Electricity (Per Cent)

	Households			Commercial			Agriculture			Industry		
	1970-71	1998-99	ACGR (%)	1970-71	1998-99	ACGR (%)	1970-71	1998-99	ACGR (%)	1970-71	1998-99	ACGR (%)
Andhra Pradesh	8.16	19.00	3.06	9.94	5.00	-2.42	18.61	34.0	2.18	50.69	33.67	-1.45
Assam	13.31	24.01	2.13	17.75	9.15	-2.34	..	2.5		55.97	28.32	-2.40
Bihar	4.83	12.73	3.52	5.09	5.07	-0.01	3.66	18.5	5.96	74.71	53.88	-1.16
Delhi (DESU)	28.26	36.51	0.92	21.0	5.63	-4.59	0.59	1.0	1.90	39.06	37.39	-0.16
Goa	NA	23.60		NA	7.59		NA	1.2		NA	58.95	
Gujarat	7.31	8.82	0.67	3.25	2.46	-0.99	12.19	39.4	4.28	72.28	38.33	-2.24
Haryana	0.62	19.76	13.16	5.61	3.24	-1.94	33.56	43.5	0.93	53.76	22.1.0	-3.12
Himachal Pradesh	16.95	16.27	-0.15	8.47	4.55	-2.19	0.85	0.5	-1.88	16.95	40.92	3.20
Jammu & Kashmir	37.65	24.04	-1.59	8.82	4.98	-2.02	5.88	17.6	3.99	35.29	13.07	-3.49
Karnataka	7.74	21.18	3.66	3.16	2.71	-0.55	6.05	48.0	7.68	76.05	21.56	-4.40
Kerala	4.34	48.95	9.04	3.53	8.45	3.17	2.20	4.42	2.52	65.93	32.59	-2.48
Madhya Pradesh	7.86	18.54	3.11	4.14	2.95	-1.20	3.45	37.5	8.89	78.12	27.07	-3.71
Maharashtra	9.57	11.58	0.68	7.15	2.95	-3.11	4.67	32.5	7.17	69.44	36.62	-2.26
Manipur	NA	50.15		NA	6.53		NA	3.0		NA	15.43	
Meghalaya	NA	18.41		NA	9.30		NA	0.4		NA	13.95	
Orissa	2.31	23.03	8.56	3.56	5.25	1.40	0.69	3.5	5.97	88.18	56.89	-1.55
Punjab	6.52	18.23	3.74	5.10	3.86	-0.99	21.93	32.8	1.45	65.50	40.53	-1.70
Rajasthan	7.80	15.24	2.42	6.43	4.90	-0.97	11.91	31.3	3.51	64.91	37.99	-1.89
Tamil Nadu	6.53	16.11	3.28	7.99	6.96	-0.49	24.78	27.0	0.31	56.96	40.90	-1.18
Tripura	NA	33.04		NA	7.02		NA	23.1		NA	13.16	
Uttar Pradesh	8.63	27.28	4.20	2.94	7.81	3.55	16.83	33.4	2.48	64.01	22.66	-3.64
West Bengal	15.63	22.25	1.27	5.66	10.11	2.09	0.51	15.7	13.02	80.32	27.03	-3.81
All India	10.78	18.41	1.93	7.20	4.86	-1.39	9.90	30.0	4.04	61.56	33.65	-2.13

Note : ACGR = Annual Average Compound Growth Rate (%).

Sources: For 1970-71, CMIE, *Energy*, March - April, 1999; for 1998-99, Planning Commission, (GOI), April 1999; For Kerala, KSEB, *Power System Statistics*

Table 8: Percentage of Villages and Households Electrified, Pumpsets Energized and Number of Consumers

	% Villages Electrified (March,1998)	% Pumpsets Energized (March,1998)	No. of Consumers (1996-97) (Million)	Connected Load (1996-97) ('000 MW)	Percentage Households having Electricity Facility (1991 Census)		
					Rural	Urban	Total
Andhra Pradesh	97.03	114.04	9.87	17.25	37.5	73.31	46.30
Arunachal Pradesh	66.35		0.08	0.05	33.88	80.96	40.85
Assam	86.47	1.84	0.71	1.70	12.44	63.21	18.74
Bihar	70.82	27.03	1.97	5.74	5.57	58.77	12.57
Goa	93.26		0.33	8.73	81.82	88.77	84.69
Gujarat	99.02	88.21	7.64	16.02	56.43	82.96	65.93
Haryana	100.21	95.21	3.29	6.63	63.2	89.13	70.35
Himachal Pradesh	98.98	50.98	1.23	1.83	85.86	96.24	87.01
Jammu & Kashmir	97.50	37.47	0.68	0.72	..	..	..
Karnataka	98.65	127.31	7.54	11.57	41.75	76.27	52.47
Kerala	100.00	109.79	4.92	6.09	41.95	67.65	48.43
Madhya Pradesh	95.24	94.54	7.96	10.43	34.49	72.52	43.30
Maharashtra	102.69	119.51	13.13	27.3	58.45	86.07	69.40
Manipur	95.33	0.45	0.13	0.12	41.73	75.45	50.92

Table 8 cont'd.........

Table 8 cont'd.........

Meghalaya	50.88	0.65	0.11	0.23	16.34	83.04	29.16
Mizoram	94.87	0.00	0.08	0.09	35.47	85.50	59.20
Nagaland	103.69	1.76	0.12	0.54	47.16	75.58	53.42
Orissa	72.23	14.41	1.23	2.98	17.45	62.11	23.54
Punjab	100.70	105.02	4.67	11.37	76.98	94.60	82.31
Rajasthan	97.95	94.18	4.61	9.26	22.44	76.67	35.03
Sikkim	92.05	0.00	0.05	0.04	57.12	92.37	60.66
Tamil Nadu	99.94	107.28	11.19	19.67	44.49	76.80	54.74
Tripura	100.00	17.64	0.14	0.18	28.50	80.43	36.93
Uttar Pradesh	78.11	32.92	6.48	13.99	10.96	67.76	21.91
West Bengal	77.11	20.88	4.06	7.95	17.75	70.19	32.90
All States	86.65	81.75	.	..			
U. T.s	97.06	73.74	.	..			
All India	86.67	81.72	94.94	187.05	30.54	75.78	42.37

Sources: Planning Commission, *Annual Report on the Working of SEBs & EDs*, Various Issues; and 1991 Census.

Table 9: Some of the Performance Indicators

	Employees per MU of Energy Sold			Employees per Thousand Consumers		
	1992-93	1996-97	ACGR (%)	1992-93	1996-97	ACGR (%)
Andhra Pradesh	3.7	3.3	-2.82	9.0	7.7	-3.83
Arunachal Pradesh	71.4	41.4	-12.74	50.0	45.6	-2.28
Assam	14.6	10.3	-8.35	38.8	28.4	-7.50
Bihar	7.6	5.5	-7.77	26.0	19.2	-7.30
Delhi (DESU)	3.3	3.5	1.48	14.2	12.6*	- 2.94*
Goa	6.0	4.6	-6.43	12.7	11.6	-2.24
Gujarat	2.5	1.9	-6.63	8.3	7.9	-1.23
Haryana	5.2	5.3	0.48	15.8	14.6	-1.96
Himachal Pradesh	6.8	5.2	-6.49	11.0	11.5	1.12
Jammu & Kashmir	10.8	9.2	-3.93	26.1	26.8	0.66
Karnataka	4.1	2.9	-8.29	7.0	5.9	-4.18
Kerala	4.1	3.8	-1.88	6.1	5.5	-2.56
Madhya Pradesh	4.9	3.7	-6.78	13.8	11.9	-3.64
Maharashtra	3.5	2.6	-7.16	12.0	9.7	-5.18
Manipur	28.9	20.1	-8.68	52.0	44.3	-3.93
Meghalaya	10.8	9.5	-3.16	51.1	39.3	-6.35
Mizoram	17.2	9.0	-14.95	21.0	16.1	-6.43
Nagaland	38.4	29.0	-6.78	40.8	33.5	-4.81
Orissa	6.1	5.5	-2.56	30.0	23.5	-5.92
Pondicherry	2.2	2.1	-1.16	11.0	10.0	-2.35
Punjab	5.0	4.1	-4.84	17.9	15.8	-3.07
Rajasthan	5.3	4.0	-6.79	16.1	12.4	-6.32
Sikkim	24.3	15.7	-10.35	41.0	27.0	-9.92
Tamil Nadu	5.0	3.5	-8.53	10.4	8.2	-5.77
Tripura	30.4	18.8	-11.32	46.0	34.8	-6.74
Uttar Pradesh	4.4	3.5	-5.56	18.7	14.7	-5.84
West Bengal	6.7	3.9	-12.65	22.3	14.7	-9.89
All India	4.6	3.6	-5.94	13.3	11.2	-4.21

Note: * = for (with respect to) 1995-96.

Source: Planning Commission, *Annual Report on the Working of SEBs & EDs*, Various Issues.

Another institutional factor breeding inefficiency has been the lack of professional management with commitment, accountability, inclination and initiative in decision making. A steady enervating erosion of competitive management values has sapped the institutional texture to the bottom, giving rise to all-round X-inefficiency. For one thing, continuity of management by top personnel at the policy making level has been a perpetual loss. In most of the SEBs, the average tenure of Chairmen and Chief Engineers is very limited – for an example, four Chairmen of KSEB in 1973-74 had tenures less than one year, out of which one of them had less than three months (Government of Kerala, 1984: 41). The new Chairman of the KSEB, who has recently taken charge, is the fourth in four years. Similarly, there were five incumbents on the chair of Chief Engineer (Planning) of the KSEB in a period of six years during 1978 to 1984 (Government of Kerala 1984: 41). The story still continues and is the same with other SEBs also. The appointments being mostly on seniority basis, by the time a person reaches the top chair, he would be on the verge of superannuation, that retards his commitment and involvement in serious policy making. Committees after committees have recommended that appointments be made based on selection, and that the selected person with proven ability and integrity should have at least 2 to 5 years further service for superannuation (Government of Kerala, 1984: 41– 42; Government of Kerala, 1997: 57–58).

Moreover, the socio-political dynamics in different States have led to a situation of wide-spread corrupt practices of nepotism, all at the cost of merit, ability, and efficiency. A general lethargic indisposition for accountability booms under such umbrellas of patronage. "Certainly improved worker selection could improve productivity at the plant level. To the extent that people are not working at what they are most proficient at, productivity should rise as a consequence of superior selection methods" (Leibenstein, 1976: 38). Leibenstein's analysis of internal motivation to efficiency starts from the premise that contracts for labour supply within the firm are incomplete, they do not include a specification of the job, so the efficiency of the labour depends on the motivation to effort, which by all counts is constrained by his preference for less effort, confined in an 'inert area'. This problem is more acute in the public sector of many developing countries, where loose contract, if at all any, guarantees job security till superannuation, whatsoever be the output of his effort. "Since there are no professional job descriptions, personnel are often assigned to areas for which they are not competent…..People are hired against general specifications and not specific job needs….Employees do not have a clear understanding of their responsibilities. Positions do not have performance objectives…(and) clearly defined selection criteria for recruitment purposes." (Government of Kerala, 1998: 5.4). Besides the superior selection procedure, linking the terms of job continuity and remuneration to productivity would certainly yield a sea of change.

3. Cost Analysis

All these inefficiencies must come out in inflated proportion in the cost of electricity supply. For all the SEBs in India, the unit cost of supply of electricity in 1974-75 was 22.5 paise per unit, which increased to 41.9 paise per unit in 1980-81 (at an annual average compound growth rate of 10.9 per cent), and further to 108.6 paise per unit in 1990-91 (at an annual rate of 10 per cent). The nineties saw sharp rise in the unit cost of supply, from 116.8 paise/unit in 1991-92 to 227.89 paise/unit in 1997-98 (at a rate of 11.8 per cent p. a.). It is expected to reach Rs. 2.43/unit in 1998-99 (an increase of 6.6 per cent). In 1997-98, the unit cost varied from Rs. 1.60/unit in Himachal Pradesh to Rs. 4.23/unit in Assam. Two important factors that cause such wide variation in unit supply cost in general are (i) the source of power, whether hydro or thermal, and (ii) the coverage of electrification of villages and households. The pure hydro-power systems of Himachal Pradesh and Meghalaya have lower unit cost; however, the higher unit cost of the pure thermal systems of Delhi and Assam is not due to higher fuel cost, but due to higher power purchase cost. Though Kerala is still a hydro-power dominant system, her unit cost of supply (Rs. 1.92/unit) exceeds that of Karnataka (Rs. 1.89/unit), now a thermal-power dominant (72 per cent) system, on account of the increased share of imported (thermal) power. If we take into account this aspect also, i.e., the sources of total energy sold out, Kerala power system would become a predominantly thermal (about 80 per cent) one. During the seventies, the average cost of electricity supply in Kerala had an annual average compound growth rate of 3.8 per cent, during the eighties, 11.8 per cent, and during 1991-92 to 1997-98, 15.4 per cent, reflecting largely the increasing impact of power purchase cost.

The major components of electricity supply cost are (i) the revenue expenditure, consisting of expenditure on fuel, power purchase, operation and maintenance (O & M), establishment and administration (E & A), and on other miscellanies; and (ii) the fixed costs, including depreciation and interest payable to institutional creditors and to the concerned State Governments.

Fuel Cost

Fuel cost has accounted for about 25 per cent of the total supply cost since 1992-93. Gujarat, Tamil Nadu, Maharashtra, and Punjab have had fuel cost share higher than the all-India average, while the pure thermal systems of Assam and Delhi, much lower (Table 10). Fuel cost depends, besides other factors, on the specific consumption of coal and oil, and the transportation costs of these fuels. The specific coal consumption of the thermal plants of the SEBs has been about 0.74 to

0.78 kg/unit since 1992-93. A number of SEBs, including that of Andhra Pradesh, Bihar, Haryana, Madhya Pradesh, Maharashtra, Orissa, and Uttar Pradesh, have had consistently higher than 0.8 kg/unit of coal consumption during this period. The specific secondary oil consumption in the coal-based thermal plants increased steeply from 7.8 ml/unit in 1992-93 to 10.8 ml/unit in 1995-96, and then dropped to reach 9.9 ml/unit in 1997-98. In the late seventies and the early eighties, it was over 12 ml/unit. The average specific oil consumption in Bihar, Haryana, and Assam has been higher than the all-India average, while that in Andhra Pradesh, Tamil Nadu, Maharashtra, Rajasthan, Madhya Pradesh (recently) and Punjab, much lower. The cost of coal per unit of electricity generation increased from 53.4 paise/unit in 1992-93 to 89.4 paise/unit in 1997-98 (at an annual growth rate of 10.9 per cent), and that of secondary oil from 3.7 paise/unit to 7.3 paise/unit (at an annual rate of 14.6 per cent) during this period (Government of India, 1999: Annexures 4.9 – 4.12). The States, viz., Gujarat, Tamil Nadu, Haryana, Punjab and Rajasthan, located farther away from coal fields have to bear higher cost of coal per unit of generation, thus having higher share of fuel component in their unit cost.

Much remains to be desired and improved in the aspect of overall thermal efficiency of the steam power plants also. 25 out of the 77 steam power stations considered in the country, accounting for 19.4 per cent of their total IC (of 50,115.48 MW) in 1996-97, reported an overall thermal efficiency below 25 per cent, and an average capacity utilization of 3,975 kWh/kW or 45.4 per cent. 19 steam stations, representing 24.2 per cent of the IC, had an overall thermal efficiency in the range of 25 to 30 per cent, and an average capacity utilization of 4,377.6 kWh/kW or about 50 per cent; and the remaining 33, with 56.4 per cent of IC, had, above 30 per cent overall thermal efficiency, and an average capacity utilization of 6,164.4 kWh/kW or 70.4 per cent. The average utilization rate for all

Table 10: Cost Structure of SEBs (1997-98) (Paise/unit sold)

SEB	Fuel	Power Purchase	O & M	Establt/ Admin.	Miscellaneous Expenditure	Depreciation	Interest	Total
Andhra Pradesh	59.33	68.00	7.65	20.71	3.08	16.62	42.02	217.41
Assam	50.72	127.78	11.71	86.74	4.40	30.01	111.84	423.20
Bihar	15.67	172.74	14.40	0	47.41	23.96	21.10	295.28
Delhi (DESU)	35.52	259.72	10.74	31.33	0	14.00	0	351.31
Gujarat	101.58	77.01	6.34	19.89	0	16.74	13.82	235.38
Haryana	53.36	99.63	11.88	39.10	0	16.92	23.2	244.09
Himachal Pradesh	0	55.00	21.23	44.53	0	6.44	32.81	160.01
Jammu & Kashmir	8.11	181.02	6.46	25.70	0	16.11	50.00	287.40
Karnataka	7.01	103.77	8.09	31.92	7.14	13.09	17.58	188.60
Kerala	4.18	70.62	5.63	48.66	6.96	9.83	46.26	192.14
Madhya Pradesh	44.81	71.43	8.91	32.89	4.14	21.98	32.71	216.87
Maharashtra	67.28	56.74	12.10	25.03	1.41	20.96	23.28	206.8
Meghalaya	0	10.46	22.83	85.41	0	11.88	36.14	166.72
Orissa	0	187.67	9.65	33.20	0.22	23.32	17.93	271.99
Punjab	75.60	42.19	6.66	41.05	1.36	17.39	41.43	225.68
Rajasthan	52.14	83.60	8.19	27.00	26.78	16.24	45.79	259.74
Tamil Nadu	89.20	46.11	5.23	42.09	0.68	14.96	18.78	217.05
Utter Pradesh	48.46	66.00	11.00	31.31	0.33	27.74	54.73	239.57
West Bengal	35.56	142.81	8.95	26.81	3.88	12.93	23.73	254.67
Average	56.19	82.42	10.02	27.29	4.18	18.09	29.70	227.89

Source: Planning Commission, *Annual Report on the Working of SEBs & EDs*, April 1999; for Kerala, KSEB, *Annual Statement of Accounts, 1997-98*.

the 77 stations was 5,307.6 kWh/kW or 60.6 per cent (Government of India, 1996-97: Table No. 45). Thus about 57 per cent of these steam stations, accounting for about 44 per cent of their total IC, were utilized for less than 50 per cent of the time, and all the stations together, about 60 per cent.

Costs of Power Purchase

Expenditure on power purchase is the largest component of the total cost of electricity supply. It increased from 27.9 per cent of the unit cost of supply of electricity in 1992-93 to 36.2 per cent in 1997-98 (at an annual growth rate of 5.3 per cent). Bihar, Delhi, Haryana, Jammu and Kashmir, Madhya Pradesh, Karnataka, Orissa and West Bengal have much higher proportion of power import cost than the all-India average; as much as 74 per cent of the unit cost of supply in Delhi was accounted for by power purchase in 1997-98, and nearly 70 per cent in Orissa. The average rate of payment for power purchase steadily increased from 76 paise/unit in 1992-93 to Rs. 1.39/unit in 1997-98 (at an annual rate of 12.7 per cent). In 1997-98, the total cost of power purchased by all the SEBs and Electricity Departments (EDs) was Rs. 24,187.4 crores. A good part of this huge cost in fact represents the price paid for the inefficiency in the T & D system. We can have an estimate of this inefficiency that stands to inflate the unit cost of electricity supply. The net generation of electricity by all the SEBs and EDs in 1997-98 is estimated to be 2,28,020.3 MU. If we assume that the T & D loss could be kept at a minimum of 15 per cent, then the energy that must be available for a sale of 2,93,478.9 MU in that year would be 3,45,269.3 MU, thus necessitating an import of 1,17,248.99 MU (about 40 per cent of the total sales) only, instead of the reported 1,74,373.9 MU (about 60 per cent of the sales), giving a saving in power purchase of 57,124.9 MU, or in power purchase cost of Rs. 7,924 crores at an average power purchase rate of Rs. 1.39/

unit, or a saving of 27 paise per unit sold[10]. This would reduce the unit cost of electricity supply to Rs. 2.01 per unit sold, against the reported Rs. 2.28/unit. Thus the cost of inefficiency in the T & D system alone comes out to be about 27 paise per unit of electricity sold ! In the case of Kerala, this is 6.16 paise per unit sold, and the unit cost of supply would then be only Rs. 1.86/unit instead of the given Rs. 1.92/unit. Remember, Kerala reported a T & D loss of 17.87 per cent only in 1997-98. On the other hand, for Delhi, the cost of inefficiency comes to 94.36 paise/unit sold, and the unit cost of supply, Rs. 2.57/unit, instead of 3.51/unit !

The burden of power purchase could still be lessened if the SEBs and EDs were able to improve their operational efficiency and thus increase their net generation. The above analysis was based on the actual figures on an average of a PLF of about 50 per cent (i.e., a utilization of 71.3 per cent at 70 per cent availability), and about 7 per cent of auxiliary consumption for all the SEBs and EDs. At 80 per cent availability, the thermal power generation in 1997-98 in the State sector implies a utilization of 69.4 per cent (and hence a PLF of 55.5 per cent); and at an (assumed) availability (dependable firm power) of 60 per cent, the hydro power generation implies a utilization of 61.45 per cent (a PLF of about 37 per cent). Now, it would be only reasonable to assume a PLF of 70 per cent (that may imply a utilization of 87.5 per cent at 80 per cent availability) for the thermal plants in the State's sector[11]. Similarly, let the hydro power stations have a PLF of 47.5 per cent (that may imply a utilization of nearly 80 per cent at 60 per cent availability). This increased operational efficiency would reduce the power purchase (of 1997-98) by 1,05,186.4 MU, assuming 7 per cent auxiliary and 15 per cent T & D consumption. This represents a saving in power purchase cost of Rs. 14,590.4 crores or 49.72 paise per unit sold, and the unit cost of electricity supply would be only Rs. 1.78 per unit ! For Delhi, such operational efficiency improvement would reduce the unit supply cost by as much as 116.91 paise per unit sold to Rs. 2.34/unit, and for Kerala, by 40.32 paise per unit to Rs. 1.52/unit, assuming 0.61 per cent of auxiliary consumption as reported !

Needless to repeat, adequate and timely capacity additions could further improve the situation. If, for example, Kerala could achieve her targets of commissioning of power plants as anticipated during the 7th, 8th and 9th Plans (as detailed in Government of Kerala 1984: Statement 2), she could still continue to enjoy being a net exporter, rather than be, as at present, one of the States worst affected by power shortage. For one thing, on the surface, the failure 'was apparently attributable to the complacency created out of the comfortable power position prevailing in Kerala until the recent failure of monsoon and the consequent power cut' (Government of Kerala 1984: 26). Deep-rooted, however, a number of factors have in accumulation wreaked havoc on the system. Some 'classical' examples of project time-overruns may rightly be credited to Kerala – Kallada (15 MW), Kakkad (50 MW), and Lower Periyar (180 MW), as also some minor projects (all hydro power projects), to have been commissioned during the 7th Plan, could finally be put on line in the mid-90s only. The time overrun (over and above the originally scheduled commissioning date, once the works started) in the case of Idamalayar project was 9 years, Kakkad, 13 years, Kallada, 5 years, Lower Periyar, 6 years, and the mini projects, Peppara, 6 years, and Madupatty, 8 years. The consequent cost overrun was Idamalayar: 285 per cent, Kakkad: 685 per cent, Kallada: 53 per cent, Lower periyar: 238 per cent, Peppara: 59 per cent, and Madupatty: 64 per cent (Government of Kerala, *Economic Review*, different issues). Ideally, a revised cost estimate should sufficiently cover the general price rise. Then what remains in the revised cost escalation of a project over and above the general price inflationary influences is a matter of serious consideration; it may represent an over-estimation due to uncertainty or an element of deliberate attempt at wasteful mismanagement of resources. In the case of most of the projects with time overruns in Kerala, the revised cost estimates significantly exceeded the general inflationary impact, signifying the effect of some 'unexplained' factors (of deliberate or otherwise mismanagement) on cost escalation. For example, for Kakkad, about 62 per cent of the cost escalation remained to be explained by factors other than general inflation, and for Lower Periyar, about 11 per cent.

The time overruns of power projects involves manifold and thus heavy costs – besides incurring the cost escalation of the projects and the power purchase costs, the system also is forced to forgo additional sales revenue obtainable. Thus the cost of inefficiency at the planning and execution level also is very high. "The basic reason for the power crisis engulfing the State (Kerala) today is mainly …..the failure, of the Electricity Board, in planning and in the timely execution of the power projects." (Government of Kerala 1997: 9) A host of factors are at work here – changes in the technical design and feasibility report, original cost estimates being based on inadequate or incomplete data and unrealistic assumptions, inefficient management, inadequate geological and technical investigations of the projects in their initial stages, vague and ambiguous specifications and conditions of contract, delays due to sluggish decision making at various stages of construction, lack of availability of materials or of transportation facilities, high mobility of planning and supervisory staff between projects during their construction, militant trade union interference, excessive ecological concerns, unwarranted court interventions for aggrieved contractors, and above all, vitiating corruption, and indifference of the public.

There is yet another factor. Power purchase agreements (PPA) often contain booby traps of forced purchase provisions[12]; in order to respect the PPA, the SEBs are sometimes compelled to back down their own cheap generators. An apt case in point here is the PPA between the NTPC and the KSEB in respect of the power from the Kayamkulam thermal station. It being completely a 'State project', the KSEB should, by PPA, purchase all the energy generated here. Though the average capacity utilization factor is set at the usual norm of 68.5 per cent, the Kayamkulam project is often operated at the full 100 per cent capacity factor, and the Board is thus forced to take in the whole lot. This in turn results in backing down some of the hydro power plants, with the cheapest generation cost of only 14 paise/unit[13]. The Chief Engineer (Thermal, O & M) of the KSEB has estimated that the Board could save Rs. 250.56 crores every year, if it needed to purchase only the normal generation (at 68.5 per cent capacity factor) from the NTPC project (*Malayala Manorama* daily, June 14, 1999).

The Board, on the other hand, seeks to save its face by scheduling these hydro power plants for repair, maintenance or renovation works, even during the monsoon, when water, if not fully utilized, would spill over from the small reservoirs of these plants. For example, (according to an estimate of the Board), during the monsoon of 1998, water worth Rs. 3.6 crores of energy was lost from the Peringalkuthu reservoir, as one unit of 8 MW capacity there had been in outage for more than $1^1/_2$ years, though it required only some minor repairs. Similarly, in Sengulam power station, one unit had been in outage for more than one year, and water worth Rs. 12 crores of energy was lost. Neriamangalam station also had the same fate in that year (*Mathrbhoomi* daily, June 21, 1999).

At present, the daily electricity consumption in Kerala is about 33 MU, and on Sundays it goes up to 35 MU. The generators closed down in the name of maintenance or repair works cost about 4 MU per day, that is about Rs. 80 lakhs a day. (The loss would be even higher if estimated at the rate of the power purchase, which could have been averted, rather than at the selling rate.) At Idamalayar (2 x 37.5 MW), one of the two generators had been in outage since February 2000, requiring only some minor repairs. The reservoir of the power station had, by mid-April, water sufficient for 105 MU of energy; and the only unit in service, if run at its maximum capacity during April and May, can consume water equivalent to only 50 MU, which in turn means spilling over of substantial quantum of water during the imminent monsoon. Kuttiady power station of 75 MW capacity has been out of service for a long time in the name of extension works for augmenting capacity by another 50 MW. During the monsoon Kuttiady is operated at its maximum, often beyond its capacity in order to utilize fully the monsoon bounty, which otherwise would spill over. The unutilized water, equivalent to 6 MU of energy (a revenue of about Rs. 12 million at the sales rate), that the small dam contains at present, would go to waste during the monsoon spill over (*Mathrbhoomi* daily, April1 6, 2000). The turnkey project work, started in 1996, should have been completed in 3 years. The Government has now allowed six more months for completion (sanctioning the demanded cost overruns to the contractor, a controversial Canadian firm), which means substantial loss of water during this monsoon also. The KSEB has estimated a daily loss of Rs. 36 lakhs, and a total loss of more than Rs. 55 crores during the six months extension period (*Malayala Manorama*, April 26, 2000).

In addition to letting some of the cheap hydro plants remain closed down in the name of maintenance or repairs, KSEB also operates its own thermal plants at minimum capacity factor. One unit of the Brahmapuram thermal plant also is in outage and the other units are run below 20 per cent of the installed capacity, while the Kozhikode thermal plant units are operated below 30 per cent. The operating costs of these plants are reported to be very high, much more than Rs. 5/unit. Though these stations are supposed to use low sulfur heavy stock (LSHS) as fuels, at present they are run on naphtha, like the Kayamkulam (NTPC) and Cochin (BSES) plants. It should be noted that nowhere in the world is naphtha, which is highly volatile and very costly, used for power generation. It was a reckless and disastrous choice for Kerala to have all her thermal plants, both commissioned and under construction or consideration, based on naphtha. And way back in 1996, the Planning Commission opposed the use of naphtha as feedstock for new power projects, considering the high generation cost per unit and the huge foreign exchange outflow that naphtha imports might entail. Kozhikode thermal plant is confronted with a threat of environmental problems also; it has not yet obtained the green clearance from the Pollution Control Board. If the Board objects, the plant will have to be closed down ! The KSEB purchases about 6.5 MU of electricity every day from the NTPC Kayamkulam thermal station at an exorbitant cost of Rs. 4.5/unit (the generation cost is reported to be Rs. 5.5/unit), while its hydro-power costs it only about 20 paise per unit (*Mathrbhoomi* daily, April 16, 2000). Though the NTPC is willing to convert this 'State project' into a regional one, in the event of which the purchase price would come down (as its PLF increases), the State Government is dragging its feet. Power from the Nuclear Power Corporation costs only Rs. 1.89/unit for Kerala, while that from the Neyveli Lignite Corporation costs Rs. 1.04/unit (First phase) and Rs. 1.87/unit (Second phase); Kerala also gets power from the NTPC Ramagundam project at Rs. 1.57/unit only (*The New Indian Express*, March 22, 2000). Thus there do remain quite feasible possibilities for adopting fruitful means to reduce the power purchase cost to a substantial extent – by converting the NTPC 'State project' into a regional one, and at the same time by ensuring an enhanced share of power from the Central pool and its regular and constant delivery.

O & M and E & A Costs

The proportion of O & M costs in the unit electricity supply cost had a marginal decrease from 4.7 per cent in 1992-93 to 4.5 per cent in 1997-98. In general, the hydro-power systems of Himachal Pradesh and Meghalaya have much higher (above 10 per cent) share of O & M costs, while Assam, Gujarat, Jammu & Kashmir, Punjab, and Tamil Nadu, much lower (about 2 to 3 per cent).

Establishment and administration (E & A) charges consist mainly of the wages and salaries of staff. Its share in unit supply cost declined from 15.2 per cent in 1992-93 to about 12.3 per cent in 1997-98. Himachal Pradesh, Kerala, and Meghalaya have very high share of E & A costs, often more than 30 per cent, while Andhra Pradesh, Delhi, Gujarat, Jammu & Kashmir, Rajasthan, Maharashtra and Uttar Pradesh show much lower share than the all-SEBs average. As already explained, over-manning especially in non-technical sections on account of the employment-providing patronage of the Governments has been another source of inefficiency. The labor productivity in the States' power sector in 1997-98 is estimated to be about 3.4 employees per MU of electricity sold, as against less than 2.5 in many developing countries[14] . We can have an estimate of this inefficiency too. The total E & A charges in 1997-98 come out to be Rs. 8,009 crores, at a unit E & A cost of 27.29 paise/unit sold, for an estimated number of 9,86,537 employees, giving an average E & A expense of Rs. 81.18 thousand per employee per year. If labor productivity increases to, say, 2 employees per MU of electricity sold, (i.e., with the given quantum of sale), then number of employees would be reduced to 5,86,958, and the E & A costs, to Rs. 4,765.1 crores. This gives a unit E & A charge of power supply of 16.24 paise per unit sold, and a unit cost saving of 11.05 paise/unit, which is the cost of inefficiency involved in over-employment. For Kerala, with an average E & A cost of Rs. 1.44 lakhs per employee per year in 1997-98 (about 1.8 times the State sector average), the cost saving is turned out to be 19.78 paise/unit sold, reducing the unit E & A cost to 28.88 paise/unit from 48.66 paise/ unit. For Delhi, it is 10.46 paise/unit, a reduction from 31.33 paise/unit to 20.87 paise/unit.

Fixed Costs

The share of fixed costs, viz., depreciation and interest payments in average cost of electricity supply declined from 25 per cent in 1992-93 to 21.7 per cent in 1997-98. Interest charges have always commanded a bigger share out of this – much more than 10 per cent. While the share of depreciation rose from 7.6 per cent in 1992-93 to 9.2 per cent in 1994-95 and then fell to 8.3 per cent in 1997-98, that of interest steadily declined from 17.5 per cent in 1992-93 to 13.5 per cent in 1997-98. Kerala, Madhya Pradesh, Maharashtra, and Uttar Pradesh have much higher stakes in depreciation, around 10 per cent; Delhi and Himachal Pradesh, on the other hand, the least, less than 5 per cent. The share of depreciation in unit cost of Kerala remains around 6 per cent.

Very high interest charges are a big problem for many States – Assam, Himachal Pradesh, Kerala, Meghalaya, and Uttar Pradesh have higher share of interest in supply cost, more than 20 per cent. Delhi maintains the lowest share position here also – nearly 4 per cent only. Note that depreciation is an important item contributing to internal resources generated, while interest charges are a real drain, and hence increased share of the latter in total cost signals financial weakness of dependence. In fact, the share of interest in supply cost could be significantly reduced in a number of potent ways. SEBs in general do not repay the State Government loans and the interest thereon. These interest charges due to State Government are usually carried forward every year, and the accumulated charges stand to make the balance sheet dip totally into the red. The situation could be eased by converting part of Government loans into equity. Originally, the Electricity (Supply) Act did not provide for an equity component, and the entire capital of SEB consisted only of loans from the State government and from institutional lenders. In general, a debt-equity ratio of 1:1 is maintained in all capital-intensive industries, including the Central power sector. Hence in 1978, the E(S) Act was amended to enable the State Governments to provide for equity by converting part of their loans into equity. However, SEBs in general are reluctant to take up this provision seriously, lest the Board's profits, likely to be exhibited consequent upon the introduction of equity capital, should be liable to income tax. Yet this inhibition condones letting the unpaid/unpayable interest charges inflate the supply cost. To the extent that this part remains unpaid, the supply cost thus calculated turns out to be an over-estimate. Recently, the Kerala Government has decided to convert Rs. 1,552 crores due to it on account of accumulated loan and interest, projected to reach Rs. 2,280 crores by 1998-99, into equity capital, stipulating that the Board, like the independent power producers (IPPs), earn a return of 16 per cent on capital employed. However, the Board still continues its practice of carrying forward the interest charges on Government loans and including the annual interest charges in total expenditure, without allowing for any reduction possible on account of equity introduction. Ideally, a 1:1 debt-equity ratio accounting practice would reduce the interest charges by one-half, such that, for instance, in 1997-98, the unit interest cost in the State sector would be reduced to 14.85 paise per unit sold, and the overall unit supply cost, to Rs. 2.13/unit sold. For Kerala, the benefit of reduction in unit interest cost would be 23.13 paise/unit sold[15].

The Cost of Inefficiencies

That the cost of electricity supply in the State sector is an over-estimate inflated by inefficiencies at all points is a foregone conclusion.

Allowing for some improvement in operational, T & D, and man-power planning efficiencies, as discussed earlier, would reduce the unit cost of supply of all-SEBs substantially, by 60.77 paise per unit sold, to Rs. 1.67/unit from Rs. 2.28/unit in 1997-98. For Kerala, the unit cost saving is 60.10 paise/unit, giving a unit supply cost of Rs. 1.32/unit instead of the reported Rs. 1.92/unit, and for Delhi, 127.37 paise/unit, the unit supply cost reducing to Rs. 2.24/unit from Rs. 3.51/unit. With a 1:1 debt-equity capital base, the unit electricity supply cost would still go down for all-SEBs to Rs. 1.52/unit sold, and to Kerala, Rs. 1.09/unit. The unit cost of inefficiency in the State sector is about 33.2 per cent of the reported unit cost of electricity supply, and in Kerala, about 43.3 per cent, and in Delhi, 36.3 per cent. And this is regardless of the unquantifiable cost of inefficiency at all other levels ! Now the pertinent question is: Should the consumer be made to pay for this inefficiency ?

It should, however, be stressed that this conclusion is in the accounting cost sense, and not in the economic, opportunity, cost sense. The latter, for instance, demands that the opportunity cost of land, given virtually free to the SEBs by the State Governments, also be included in the total cost of supply. Moreover, the straight line depreciation method, followed for accounting by the SEBs, can by no means reflect economic depreciation in considerations of the actually required replacement cost.

4. Tariff and Revenue Realization

In general, increasing block rate tariff that penalizes higher consumption levels because of capacity shortage is in practice in India. Hence the average tariff (or more precisely average revenue, AR, as it is reported) at the aggregate level cannot be the price confronting the customer in his decision making options; rather it can be only a supply price to the utility. The average price for sales of electricity by the SEBs was 18.8 paise/unit in 1974-75, 32.3 paise/unit in 1980-81 (growing at an annual average compound rate of 9.45 per cent), which increased to 81.8 paise/unit in 1990-91 (at an annual rate of 9.74 per cent). During the nineties, AR increased steeply from 89.1 paise/unit in 1991-92 to 184.5 paise/unit in 1997-98 (at an annual rate of 12.9 per cent). It is expected to grow further by 7.25 per cent to 197.85 paise/unit in 1998-99. During the seventies and eighties, the growth in AR was slightly less than that in AC, but in the nineties, the former exceeded the latter. Larger inter-State variations mark this trend. In 1980-81, Bihar, Gujarat, Madhya Pradesh, and West Bengal had higher AR (more than 40 paise/unit); and Meghalaya had the lowest, 22.6 paise/unit. In 1990-91, Maharashtra and West Bengal had AR greater than 100 paise/unit, and Delhi, Assam, and Rajasthan, greater than 90 paise/unit; Jammu & Kashmir had the lowest, about 36 paise/unit. In 1997-98, Assam, Bihar, Maharashtra, and Orissa reported AR estimates greater than Rs. 2/unit, and Jammu & Kashmir still maintained the lowest – 39.3 paise/unit. During the seventies, the AR realized from electricity sales in Kerala registered an annual growth rate of 11.6 per cent, during the eighties, about 8 per cent, and during 1991-92 to 1997-98, 13.3 per cent. Since the eighties, growth in AR in Kerala has been lagging behind that in AC.

Though the SEBs are empowered by the E(S) Act to determine prices with the State Governments expected to have only an advisory role, it is the latter that effectively take decisions. The socio-political compulsions of distributional solicitude of the Governments have resulted in significant distortions in setting tariffs for various consumer categories in line with the cost involved in supplying each group. Thus the cost of providing electricity to low voltage (LV) consumers (domestic, agriculture, commercial, etc.) is much higher on account of the additional cost of extensive distribution network, and more importantly, of higher distribution loss of energy, than the high voltage (HV) and extra high voltage (EHV) industries. However, the agricultural and domestic consumers enjoy a privilege of heavily subsidized supply of electricity at the cost of others. The AR realized from these two sectors is significantly lower than the overall AR, while that from the commercial customers, industry and railway traction is much higher. Agricultural consumption is charged at the lowest. In 1997-98, the AR from this sector was 27.7 paise/unit and from the domestic sector, Rs. 1.34/unit, against the overall AR of Rs. 1.85/unit. On the other hand, commercial customers paid on an average Rs. 3.33/unit and the industrial customers, Rs. 2.85/unit. The AR realized from the railway traction was the highest, Rs. 3.75/unit in that year. During 1992-93 to 1997-98, the overall AR realized grew at an annual average compound rate of 11.9 per cent, while the AR from the industrial sector, at a rate of 10.7 per cent, that from the agricultural sector, at 11.5 per cent, domestic sector, 11.6 per cent, railway traction, 12.6 per cent, and commercial sector, 15.1 per cent (Table 11).

Subsidized Power Supply

There are wide inter-State variations in the structure of subsidized supply of electricity. A consensus decision was taken at a conference of State Power Ministers in January 1993 to charge at least 50 paise/unit for agricultural power consumption. The consensus was repeated in 1996 also and a Common Minimum Action Plan for Power was put out in December 1996. This tariff was to rise, within three years, to 50 per cent of the unit cost of generation. But only a few States have implemented the minimum tariff policy – for example, Orissa and Haryana, where the sector has been restructured. Kerala realized about 55 paise/unit of AR from the agricultural sector in 1997-98; in the previous year, it was only 29 paise/unit. Andhra Pradesh, Gujarat, Jammu & Kashmir, Maharashtra, Rajasthan, Uttar Pradesh, and West Bengal provide for agricultural consumption at rates less than 50 paise/unit, and Tamil Nadu and Punjab, virtually free. In Karnataka and Madhya Pradesh also power supply to agriculture is free, but they have specified certain thresholds of connected load (10 HP in Karnataka, and 5 HP in Madhya Pradesh) above which some rates are charged. In Maharashtra, a paradoxically discriminatory tariff structure is meted out to the agriculture sector – (i) metered tariffs for irrigation pumps used in food crops fields that consume relatively much less electricity, and (ii) unmetered flat-rate tariff, based on the horse power, for pumps in water-intensive cash crops fields that consume a lot more electricity ! The power of ‘sugar politics’ overwhelms any economic logic in the allocation and use of such scarce resources as water and power.

Domestic consumers are favoured in Jammu & Kashmir, Himachal Pradesh, Kerala, Madhya Pradesh, Meghalaya, and West Bengal, the lowest rate being in Jammu & Kashmir, 32 paise/unit. All other States charge more than 100 paise/unit for domestic consumption, the AR realized from this sector in Punjab, Gujarat and Haryana being greater than their overall AR. On the other hand, the AR realized from industrial and commercial sectors were in general more than double that from domestic sector and more than 10-times that from agricultural sector in 1997-98. It was so in most of the States also. In Kerala, the proportion of the AR in the domestic, industrial and commercial sectors in 1997-98 was 1 : 2.06 : 3.6, while for all-SEBs, it was 1 : 2.13 : 2.5, for Karnataka, 1 : 2.56 : 4.23, for Tamil Nadu, 1 : 2.2 : 2.76 and for Andhra Pradesh, 1 : 1.98 : 2.2.

The inefficiency due to Government interference in price determination[16] favouring the agricultural and domestic sectors has much to do with the financial performance of the SEBs. While electricity sales to these two sectors accounted for nearly one-half of the total sales, revenue realized from them was only about one-sixth of the total sales revenue of the SEBs in the recent years.

Table 11: Customer Category-wise Average Tariff, 1997-98 (Paise/unit)

	Domestic	Commercial	Agricultural	Industrial	Average	Average Tariff/Cost Ratio (%)				
						Domestic	Commercial	Agricultural	Industrial	Overall
Andhra Pradesh	167.0	367.8	17.4	330.3	188.5	76.81	169.17	8.00	151.92	86.70
Assam	145.9	297.0	166.8	209.4	216.6	34.48	70.18	39.41	49.48	51.18
Bihar	109.3	211.4	14.0	275.9	210.7	37.02	71.59	4.74	93.44	71.36
Delhi (DESU)	258.7	237.0	116.0	299.4	270.7	73.64	67.46	33.02	85.22	77.05
Gujarat	200.0	371.0	20.0	336.8	193.0	84.97	157.62	8.50	143.09	82.00
Haryana	238.0	338.0	55.0	338.0	178.8	97.51	138.47	22.53	138.47	73.25
Himachal Pradesh	60.0	210.0	50.0	182.8	162.3	37.50	131.24	31.25	114.24	101.43
Jammu & Kashmir	32.0	58.0	12.5	47.3	39.3	11.13	20.18	4.35	16.46	13.67
Karnataka	118.3	500.3	87.1	302.9	163.7	62.73	265.27	46.18	160.60	86.80
Kerala	77.99	279.9	54.6	160.85	124.6	40.59	145.66	28.43	83.71	64.85
Madhya Pradesh	74.5	337.5	10.0	401.8	176.2	34.35	155.62	4.61	185.27	81.25
Maharashtra	162.8	281.9	25.5	345.3	213.8	78.72	136.32	12.33	166.97	103.38
Meghalaya	83.8	160.0	50.0	163.9	130.0	50.26	95.97	29.99	98.31	77.98
Orissa	123.8	235.0	65.8	256.2	218.0	45.52	86.40	24.19	94.19	80.15
Punjab	148.2	276.5	0	241.2	139.7	65.67	122.52	0	106.88	61.90
Rajasthan	144.0	300.0	38.0	304.7	194.9	55.44	115.50	14.63	117.31	75.04
Tamil Nadu	146.2	403.0	0	321.4	197.1	67.36	185.67	0.00	148.08	90.81
Utter Pradesh	108.9	354.0	44.7	335.5	171.5	45.46	147.76	18.66	140.04	71.59
West Bengal	94.3	214.0	29.7	246.7	194.0	37.03	84.03	11.66	96.87	76.18
Average	133.9	333.3	27.7	284.8	184.5	58.76	146.25	12.15	124.97	80.96

Note: For Delhi, Annual plan estimates for 1998-99.
Source: As in Table 10.

5. Financial Performance

Commercial Losses

That revenue realized from sales must be sufficient at least to recover costs of supply is the basic prerequisite for the health of any industry. Starting from this premise and comparing revenue realized with cost incurred in the power sector serve the purpose of highlighting the parlous financial position of the SEBs, which in turn is used to justify the clamour and claim for reforms. The revenue-cost ratio went down recently to as low as 76 per cent (in 1995-96), i.e., the sales revenue was enough just to recover 76 per cent of the supply cost. The cost recovery ratio has slightly improved since then. In 1974-75, it was 83.4 per cent, which decreased to 77 per cent in 1980-81 (at an annual average decay rate of 1.3 per cent), and further to 75.3 per cent in 1990-91 (at a rate of 0.23 per cent). It tried to regain in the next two years a little of what it had lost and reached up to 82.2 per cent in 1992-93, but only to climb down in the following years. Among the 19 States considered, Maharashtra has had almost always the highest cost recovery ratio – greater than 90 per cent. In fact, in the early 90s, the ratio was nearly 100 per cent, and in 1997-98, it was estimated to be about 98 per cent. Himachal Pradesh and Tamil Nadu also had a ratio greater than 90 per cent in the recent past. Himachal Pradesh has the unique distinction of being the only State having had a sales-revenue that actually exceeded the cost in one year (1996-97). Assam, Haryana, Jammu & Kashmir, Punjab, and Uttar Pradesh had less than 70 per cent cost recovery ratio in most of the years, and J & K had the lowest, less than 20 per cent (see Table 12).

The cost-revenue deviation or commercial loss (see Table 13) of the SEBs (without subsidy) increased from Rs. 4,560 crores (implying a rate of return (RoR) of (–) 12.7 per cent) in 1992-93 to Rs. 10,684 crores

(RoR of (–) 18 per cent) in 1997-98 (at an annual growth rate of 18.6 per cent), and is projected to increase to Rs. 12,323 crores (RoR of (–) 18.7 per cent) in 1998-99 (at a growth rate of 15.3 per cent). The 1983 amendment to the Section 59 of the E(S) Act, 1948, requires the SEBs to ensure that the total revenues in any year of account shall, after meeting all expenses properly chargeable to revenues, including operating, maintenance, and management expenses, depreciation and interest payable, as also taxes, if any, leave such surplus as not less than 3 per cent, or such higher percentages, as the State governments may specify, of the value of fixed assets of the Board in service at the beginning of such year. Thus the goal of tariff-making has become predetermined. Yet, a tariff mechanism in line with the basic tenets of tariff-setting still remains to be properly evolved in order to achieve this set goal. At present, the tariff structure includes capacity (demand) and energy charge components for large consumers, and consumption slabs for small consumers. It should also reasonably incorporate the distinct cost elements of fixed capacity costs, variable energy costs and customer-related costs on equipment, metering, billing and collection, in the spirit of Hopkinson rate structure[17]. Despite the set goal of at least 3 per cent RoR, a marked deterioration has been observed in the trend of the RoR of the SEBs in general.

Such commercial loss suggests that if the total revenue earned by the SEBs had been enough to cover the total costs, an additional amount, say, of Rs. 10,684 crores would have been available in 1997-98 for reinvestment in the power sector. That an accumulated amount of Rs. 45,177 crores would have been available with the SEBs during the 6 years from 1992-93 for ploughing back in the sector, had the total cost been recouped, brings out the extent of the colossal loss the SEBs suffer over time. Achieving a minimum 3 per cent RoR would have mobilized additional revenue of Rs. 12,099.2 crores in 1997-98, and a break-even

RoR, Rs. 10,487.5 crores. Universal adoption of the minimum 50 paise/ unit tariff for agricultural sales would have generated additional resource of Rs. 2,254.2 crores in the same year. Such additional revenue could have comfortably been used for capacity expansion and for improving the performance of the existing assets. This would have also reduced the burden of the State governments' having to provide the SEBs with subvention. That all these would have been possible every year leaves one sickened and cynical at the morbid sector.

Maharashtra's was the only SEB that earned a profit in 1997-98 (Rs. 111.8 crores) and in the case of other SEBs, the commercial loss ranged from Rs. 18.9 crores for Himachal Pradesh to Rs. 1,735.8 crores for Uttar Pradesh. Gujarat and Punjab also had a loss of more than Rs. 1000 crores, and as many as 7 other SEBs, more than Rs. 500 crores (see Table 13). In the early nineties also Maharashtra reported profit. It should be pointed out that in general, the SEBs carry forward accumulated losses and hence even if a particular year turns out profit, the cumulative reserves may be negative. For example, the Kerala SEB earned net profit in 1989-90 and again continuously during 1992-96, technically reporting the statutory requirement of 3 per cent rate of return. However, in all these years, KSEB suffered cumulative losses of no small magnitude.

Though subvention from the State Governments has improved the situation, the RoR has still remained negative, the commercial loss, for example in 1997-98, coming down to Rs. 6,977.8 crores, and the RoR, to (-) 11.7 per cent. Subvention has secured positive RoR of about 3 per cent for Karnataka all these years in the nineties. Gujarat, Himachal Pradesh, Orissa, Rajasthan and Tamil Nadu also reported profit and positive RoR for some of the years. As many as 6 SEBs suffered losses greater than Rs 500 crores in 1997-98 even with the support of subsidy, Punjab leading the list with a loss of Rs. 1,346 crores. Implementing the

Table 12: Average Costs and Revenues of SEBs (Paise/unit)

	1980-81			1990-91			ACGR of	1997-98			ACGR of	
	Average Cost	Average Tariff	Tariff / Cost(%)	Average Cost	Average Tariff	Tariff / Cost (%)	Tariff / Cost (1980-91)	Average Cost	Average Tariff	Tariff/ Cost (%)	Tariff/ Cost Ratio (1990-98)	(1980-98)
Andhra Pradesh	37.80	37.30	98.68	78.72	74.49	94.63	-0.42	217.44	188.5	86.69	-1.24	-0.76
Assam	76.46	38.58	50.46	249.59	98.84	39.60	-2.39	423.17	216.6	51.19	3.73	0.08
Bihar	67.68	43.21	63.84	168.97	88.56	52.41	-1.95	295.28	210.7	71.36	4.51	0.66
Delhi (DVB)	..	..	..	137.89	99.10	71.87	..	365.02	265.1	72.63	0.15	
Gujarat	46.01	40.10	87.15	110.11	78.00	70.84	-2.05	235.37	193.0	82.00	2.11	-0.36
Haryana	40.31	29.52	73.23	103.66	66.63	64.28	-1.30	244.09	178.8	73.25	1.88	0.00
Himachal Pradesh	59.71	29.98	50.21	94.77	79.13	83.50	5.22	160.17	162.3	101.33	2.80	4.22
Jammu & Kashmir	..	..	..	125.59	35.92	28.60	..	290.47	39.3	13.53	-10.14	
Karnataka	26.26	28.22	107.46	82.55	81.34	98.53	-0.86	188.59	163.7	86.80	-1.79	-1.25
Kerala	22.38	**24.**40	109.03	68.17	52.58	77.13	-3.40	199.04	126.9	63.76	-2.68	-3.11
Madhya Pradesh	52.44	40.17	76.60	116.44	84.86	72.88	-0.50	218.12	176.2	80.78	1.48	0.31
Maharashtra	36.52	28.41	77.79	107.44	103.06	95.92	2.12	218.24	213.8	97.97	0.30	1.37
Meghalaya	27.99	22.64	80.89	137.28	59.21	43.13	-6.09	168.19	130.0	77.29	8.69	-0.27
Orissa	37.57	31.99	85.15	71.43	67.89	95.04	1.11	272.03	218.0	80.14	-2.41	-0.36
Punjab	36.46	23.29	63.88	106.79	54.87	51.38	-2.15	226.64	139.7	61.64	2.63	-0.21
Rajasthan	39.12	28.01	71.60	114.59	92.91	81.08	1.25	259.57	194.9	75.09	-1.09	0.28
Tamil Nadu	43.82	30.42	69.42	114.32	86.53	75.69	0.87	217.06	197.1	90.80	2.63	1.59
Utter Pradesh	56.33	35.38	62.81	110.04	73.09	66.42	0.56	239.59	171.5	71.58	1.07	0.77
West Bengal	49.00	41.34	84.37	157.19	104.19	66.28	-2.38	254.70	194.0	76.17	2.01	-0.60
Average	41.90	32.30	77.09	108.59	81.80	75.33	-0.23	227.89	184.48	80.95	1.03	0.29

Note: ACGR = Annual Average Compound Growth Rate (%).
Source: As in Table10.

proposed national minimum agricultural tariff of 50 paise/unit across all the States also would not have saved the SEBs out of the red. The RoR in 1997-98, for instance, would still have been negative, (-) 10.5 per cent.

Losses Due To Subsidized Power Supply

A major factor that determines the level of commercial loss is the differential pricing policy. Loss results if the Government subsidy payments and cross subsidy from other sectors are not enough to neutralize the effective subsidies given to agriculture and domestic consumers. Effective subsidy (cross subsidy) is defined as $(AC - AR_i)Q_i$, where AC is the average cost of power supply, AR_i is the average revenue realized from the i^{th} sector and Q_i is the total power sold to that sector. If this expression is positive, it is taken as a subsidy to the i^{th} sector, and if it is negative, as a cross subsidy from the i^{th} sector. On this basis, it can be seen that the effective subsidy to agriculture in general increased from Rs. 7,335 crores in 1992-93 to Rs. 17,531 crores in 1997-98 (at an annual average growth rate of 19 per cent), and that to domestic sector from Rs. 2,035 crores to Rs. 4,685 crores during the same period (at a rate of 18.15 per cent per year). The subsidy given by the State Governments, on the other hand, increased from Rs. 3,182 crores to Rs. 3,706 crores only (at an annual rate of only 3.1 per cent), and the cross subsidies from the other sectors (industry, commercial and railway traction) from Rs. 3,911 crores to Rs. 11,289.3 crores during this period (at an annual rate of 23.62 per cent). These two together could neutralize only about 57 to 83 per cent of the effective subsidies provided during this period. Note that not all States compensate the SEBs for the subsidized electricity sales to agriculture and domestic consumers. For example, in 1997-98, 8 State Governments (out of 19) did not provide any compensation at all, and in the case of Assam, it was too nominal. Some of the State

Table 13: Commercial Losses Due to Differential Pricing Policy (Rs. Crores)

	With Subsidy			Without Subsidy		
	1992-93	1997-98	ACGR (%)	1992-93	1997-98	ACGR (%)
Andhra Pradesh	4.3	503.4	159.2	4.3	503.4	159.2
Assam	205.4	440.5	16.5	205.4	440.6	16.5
Bihar	279.6	370.2	5.8	279.6	370.2	5.8
Delhi (DVB)	207.3	759.9	29.7	207.3	759.9	29.7
Gujarat	100.0p	770.0	(-)	519.0	1270.0	19.6
Haryana	368.3	275.6	-5.6	403.6	525.6	5.4
Himachal Pradesh	1.6p	18.9	(-)	1.7p	18.9	(-)
Jammu & Kashmir	224.5	608.6	22.1	224.5	608.6	22.1
Karnataka	32.2p	60.7p	13.5	19.4	308.5	73.9
Kerala	65.3	218.8	27.4	65.4	370.8	41.5
Madhya Pradesh	112.9	322.1	23.3	492.9	697.1	7.2
Maharashtra	161.6p	111.8p	-7.1	161.6p	111.8p	-7.1
Meghalaya	1.9	10.1	39.7	8.4	19.1	17.9
Orissa	26.0p	257.9	(-)	85.4	300.9	28.6
Punjab	626.3	1346.0	16.5	626.3	1346.0	16.5
Rajasthan	22.1p	506.6	(-)	259.5	506.6	14.3
Tamil Nadu	92.4p	194.8	(-)	257.6	469.8	12.8
Utter Pradesh	807.5	63.8	-39.8	807.5	1735.8	16.5
West Bengal	257.5	483.1	13.4	257.5	544.1	16.1
Total	2724.9	6977.8	20.7	4560.3	10684.2	18.6

Note: p = Profit; ACGR = Annual Average Compound Growth Rate (%).
Source: As in Table 10.

governments, on the other hand, write off the interest due to them also in compensation for the subsidized sales. Moreover, the tilt in the compensating mechanism has been to tax the other sectors heavily and tap the maximum cross subsidies; in 1997-98, the State Government subsidy constituted only 17 per cent of the total effective subsidy to agriculture and domestic sectors, while the cross subsidy accounted for about 51 per cent of it. Such over-burdening would have very serious impact on the competitive and healthy operation of these sectors and drive them on to set up their own captive generation.

Agriculture has accounted for around 80 per cent of the total effective subsidies. Andhra Pradesh, Gujarat, Haryana, Karnataka, Madhya Pradesh, Maharashtra, Punjab, Rajasthan, Tamil Nadu, and Uttar Pradesh, where agricultural consumption is higher, suffer substantial losses due to subsidized power sales (Tables 14 A and B). Remember in Punjab and Tamil Nadu, the subsidy is cent per cent, and in Karnataka and Madhya Pradesh, it is nearly so. Even the introduction of the national minimum agricultural tariff of 50 paise/unit would still leave a significant gap uncovered. In 1997-98, for example, this gap was of the order of Rs. 15,277.2 crores. Similarly, subsidized domestic power consumption has been responsible for very high losses in Delhi, Kerala, Madhya Pradesh, Maharashtra, and Uttar Pradesh. Kerala had a cost-recovery ratio in 1997-98 of 40.6 per cent in the domestic sector, 28.4 per cent in agriculture, 83.7 per cent in industry, and 145.7 per cent in the commercial sector (see Table 11). Since agriculture accounts for only 4.4 per cent of the total power consumption, subsidy-bred loss cannot be very high from this sector. However, the domestic and industrial sectors' consumption constitutes about 82 per cent of the total, and thus imposes a heavy burden of loss due to subsidy, especially the domestic sector, which consumes nearly 50 per cent of the total power. It should be pointed out that about 180 thousand households, consuming less than 20 units in a month, are given free power in Kerala. Moreover, in a bid to attract industries, Kerala also allows reduced rates for new industries for the first 5 years, while most of the other SEBs charge the ruling rate, with the subsidy going directly to the beneficiaries from the State Governments. However, the very rationale for such industrial subsidy in Kerala has soon got defeated, as almost all of these new (metal, chemical, etc.) industries sprung up in the State under the subsidy umbrella have been capital- and energy-intensive with very limited prospects for creating employment opportunities, the prime objective of the subsidy scheme. An estimate has put the loss to the KSEB at more than Rs. 30 crores a year on account of the subsidized power sales to these new industries that employ less than 800 workers in all ! Unlike in most of other States, it is the commercial sector alone that is made to bear the burden of cross subsidization in Kerala.

The Receivables and the Dues

To ensure financial health of SEBs, it should be ensured in turn that the prescribed tariffs are adequate for the purpose and are reviewed periodically and revised, whenever necessary, consistent with the trend of the operational parameters, input costs, etc. In addition, and more importantly, it should also be ensured that the sales revenue these tariffs yield is collected regularly in time and the outstanding dues are kept to the minimum possible. As revenue arrears accumulate, the very purpose of tariff revision gets defeated; and sadly this is so in almost all the States. The uncovered revenue dues outstanding against different consumers in the State power sector was always on the increase over time, for example, from Rs. 6,720 crores in 1992-93 to Rs. 11,535 crores in 1996-97, growing at an annual rate of 14.5 per cent. Accounting for about 26 to 36 per cent of the annual sales turnover, these arrears represent about 4 months' sales revenue being locked up with the consumers at any point of time, against the maximum allowable norm of two months'

Table 14 (A): Commercial Losses Due to Differential Pricing Policy (Rs.Crores)

	Loss due to Effective subsidy to								
	Agriculture						Domestic Sector		
	At Current Tariff *			At 50 Ps. per Unit *					
	1992-93	1997-98	ACGR (%)	1992-93	1997-98	ACGR (%)	1992-93	1997-98	ACGR (%)
Andhra Pradesh	725.9	1815.5	20.12	395.2	1519.7	30.91	40.4	255.8	44.65
Assam	6.2	14.1	17.86	6.2	14.1	17.86	37.2	118.9	26.16
Bihar	267.6	390.8	7.87	207.3	340.8	10.45	40.0	177.9	34.78
Delhi (DVB)	8.6	25.4p	24.18	7.8	25.4p	26.63	297.4	422.7p	7.28
Gujarat	1055.4	2503.9	18.86	751.8	2155.1	23.44	88.0	92.1	0.91
Haryana	456.8	742.7	10.21	342.9	742.7	16.72	95.6	11.0	-35.11
Himachal Pradesh	1.0	1.4	6.96	0.8	1.4	11.84	13.7	45.1	26.91
Jammu & Kashmir	27.5	116.7	33.52	20.7	101.0	37.30	49.5	156.4	25.87
Karnataka	496.5	825.2	10.69	249.8	825.2	27.00	22.5	220.7	57.88
Kerala	0	51.7	..	0	51.7	..	60.5	344.3	41.59
Madhya Pradesh	421.1	1854.2	34.51	329.3	1497.8	35.39	252.7	592.9	18.60
Maharashtra	1030.9	2875.8	22.77	741.0	2510.2	27.64	151.6	295.5	14.28
Meghalaya	0	0.2	..	0	0.2	..	1.4	7.6	40.26
Orissa	20.7	48.3	18.47	14.9	48.3	26.52	80.4	228.3	23.21
Punjab	687.1	1473.1	16.48	444.9	1148.1	20.88	54.3	252.1	35.94
Rajasthan	347.5	1040.9	24.53	285.9	984.5	28.06	183.3	264.8	7.63
Tamil Nadu	642.5	1561.7	19.44	384.5	1202.0	25.60	141.8	304.6	16.52
Utter Pradesh	1035.4	1890	12.79	878.9	1838.6	15.91	331.8	987.7	24.38
West Bengal	104.2	324.9	25.54	81.7	295.6	29.33	92.9	329.3	28.80
Total	7334.9	17531.3	19.04	5143.4	15277.2	24.33	2034.9	4685.0	18.15

Note: p = Plan estimate for 1998-99; ACGR = Annual Average Compound Growth Rate (%).

* - excluding the subsidy for rural electrification given by the State Govts.

Source: Planning Commission, (GOI), *Annual Report on the Working of SEBs and EDs*, April 1999.

Table 14 (B): Structure of Subsidization (Rs.Crores)

	Total Subsidy (to Agriculture + Domestic)			Subsidy Received from State Govt.			Cross Subsidy from Other Sectors		
	1992-93	1997-98	ACGR (%)	1992-93	1997-98	ACGR (%)	1992-93	1997-98	ACGR (%)
Andhra Pradesh	766.3	2071.3	22.00	0	0	..	668.0	1321.4	14.62
Assam	43.4	133.0	25.10	0.1#	0.1	0	-148.0	-381.3	(-)
Bihar	307.6	568.7	13.08	0	0	..	-66.0	267.9	(+)
Delhi (DVB)	306.0	448.1	7.93	0	0	..	71.0	-595.5p	(-)
Gujarat	1143.4	2596.0	17.82	619.0	500.0	-4.18	319.0	1334.3	33.14
Haryana	552.4	753.7	6.41	35.0	250.0	48.17	23.0	269.0	63.53
Himachal Pradesh	14.7	46.5	25.90	0	0	..	-6.7	128.3	(+)
Jammu & Kashmir	77.0	273.1	28.81	0	0	..	-118.0	-355.8	(-)
Karnataka	519.0	1045.9	15.04	51.6	369.2	48.23	475.0	1241.6	21.19
Kerala	60.5	396.0	45.61	8.6 #	152.0	77.61	-1.5	167.4	(+)
Madhya Pradesh	673.8	2447.1	29.43	380.1	375.0	-0.27	310.0	1457.8	36.29
Maharashtra	1182.5	3171.3	21.81	0	0	..	1135.0	3028.2	21.69
Meghalaya	1.4	7.8	40.99	6.5	9.0	6.72	0.3	-4.0	(-)
Orissa	101.1	276.6	22.30	1390.0	43.0	-50.10	-166.7	-84.7	(+)
Punjab	741.4	1725.2	18.40	0	0	..	35.0	146.9	33.23
Rajasthan	530.8	1305.7	19.72	281.6	560.5*	14.76	87.0	342.2	31.51
Tamil Nadu	784.3	1866.3	18.93	350.1	275.0	-4.71	461.0	1341.0	23.81
Uttar Pradesh	1367.2	2877.7	16.05	1237.0	1672.0	6.21	920.0	990.1	1.48
West Bengal	197.1	654.2	27.12	68.1	61.0	-2.18	-86.4	78.9	(+)
Total	9369.8	22216.3	18.85	3182.0	3706.4	3.10	3911.0	11289.3	23.62

Note: * for 1996-97; # = for 1994-95; p = Plan estimate for 1998-99. Source: As in Table 14 (A).

sales revenue. States like Bihar and Jammu & Kashmir have revenue arrears of up to 183 per cent (in 1996-97) and 228 per cent (in 1995-96) respectively of their annual sales, equivalent to about 22 and 27 months' sales revenue respectively, while it is at the lowest in Tamil Nadu with 2 to 4 per cent (i.e., 7 to 15 days' sales) only. Assam, Delhi, Uttar Pradesh, and West Bengal had often more than 50 per cent turnover of revenue arrears, i.e., more than 6 months' sales, while for Kerala, 23 to 43 per cent, i.e., about 3 to 5 months' sales (see Table 15). In 1997-98, it was about 41 per cent for Kerala, nearly 5 months' sales. Besides these receivables against electricity supply, there are other sundry debtors also, which, for example, in Kerala amounted to Rs. 326 crores in 1996-97 and Rs. 319 crores in 1997-98, about 47.1 and 32.8 per cent of, or 6 and 4 months', sales revenue respectively. Regular and timely collection of all receivables could increase the liquidity available with the SEBs and arrest the excessive loan-tropism. For instance, if all the SEBs could limit the revenue arrears receivable to nearly two months' sales norm, additional revenue collected of Rs. 4,490 crores would be available with them in 1996-97, which in turn means that they could dispense with additional loans of the order of about Rs. 4,500 crores in that year or be relieved of some of the old loans. In other words, this is the cost of inefficiency in the management of sundry debtors in 1996-97. For 1995-96, this amounts to Rs. 7,567 crores. That every year such huge cost of liquidity restriction is left to be incurred explains the financial accountability of the SEBs.

While on one side the receivables to the SEBs mount up, so are their own outstanding dues to the major Central power sector undertakings such as National Thermal Power Corporation (NTPC), National Hydro Power Corporation (NHPC), Damodar Valley Corporation (DVC), Power Finance Corporation (PFC), etc. (see Table 15). These arrears (with surcharge) to be paid by the SEBs are reported as on September 30,

Table 15: Outstanding Dues to Central Enterprises and Revenue Arrears (Rs. Crores)

	Outstanding Dues			Revenue Arrears Receivable					
	as by 1995	as by 1997	ACGR (%)	1992-93	1996-97	ACGR (%)	As % of Sales Revenue		
							1992-93	1996-97	ACGR (%)
Andhra Pradesh	158	196.4	11.49	345.9	566.7	13.14	18.9	17.2	-2.33
Assam	189	-10.8	(-)	85.2	235.2	28.90	44.3	55.8	5.94
Bihar	1033	509.9	-29.74	613.0	2317.6	39.44	92.3	182.5	18.58
Delhi (DESU)	522	NA	..	499.2	2192.0 $	63.75$	46.6	140.5 $	44.47$
Gujarat	173	238.0	17.29	590.0	1031.0	14.97	31.8	24.9	-5.93
Haryana	641	NA	..	479.2	516.5	1.89	76.6	36.7	-16.80
Himachal Pradesh	35	11.7	-42.18	34.2	59.5	14.85	20.0	16.6	-4.55
Jammu & Kashmir	323	69.1	-53.75	81.9	140.5	14.45	151.7	226.9	10.59
Karnataka	54	74.9	17.77	409.2	760.6	16.76	34.0	35.6	1.16
Kerala	320	31.1	-68.83	99.8	211.6	20.67	23.1	31.5	8.06
Madhya Pradesh	717	357.5	-29.39	394.2	1045.2	27.61	20.4	24.9	5.11
Maharashtra	431	36.4	-70.94	1125.1	1840.0 $	17.82	26.1	26.2 $	0.13$
Meghalaya	88	1.1	-88.82	NA	66.7 $	..	..	122.3 $	..
Orissa	380	NA	..	184.3	NA	..	44.0	..	..
Punjab	550	153.9	-47.10	127.4	248.5	18.18	12.5	10.2	-4.96
Rajasthan	500	0	(-)	211.5	455.8	21.16	17.7	19.2	2.05
Tamil Nadu	1671	NA	..	70.0	94.0	7.65	3.8	2.1	-13.78
Utter Pradesh	2054	2349.4	6.95	1171.6	3005.2	26.55	48.5	77.7	12.50
West Bengal	627	NA	..	198.6	847.2	43.71	58.6	57.9	-0.30
Total	10465			6720.3	11534.9	14.46	30.3	26.2	-3.57

Note: $ = for (with respect to) 1995-96. ACGR = Annual Average Compound Growth Rate (%)

Source: As in Table 14 (A).

1998, to be over Rs. 16,800 crores. Some of the SEBs are overwhelmed by these dues – Uttar Pradesh (over Rs. 3,480 crores), Bihar (over Rs. 3,010 crores), and West Bengal (over Rs. 1,600 crores) (Governmant of India 1999: 89). On the other hand, some of the Central sector undertakings are left poor by substantial amounts of receivables – NTPC: Rs. 8,847 crores, NHPC: nearly Rs. 2,357 crores, and REC: nearly Rs. 2,727 crores.

Commercial Losses Due to Inefficiencies

Now let us analyze this situation a little more objectively in terms of the inefficiency estimates we have obtained earlier. To start with, remember that with some, quite reasonably achievable, improvement in the operational, T & D, and manpower deployment efficiencies, as well as with 1:1 debt-equity capital structure, the all-SEBs' 1997-98 unit cost of electricity supply has been found to fall to Rs. 1.52/unit. A summary of unit cost savings from efficiency improvement, for all-India and Kerala, is given in Table 16. Compare this with the AR realized from sales of Rs. 1.85/unit in that year. This would yield an additional revenue of about Rs. 9,459 crores over and above the total cost of electricity supply – a commercial profit! Similarly, Kerala could earn a profit of Rs. 121.06 crores and Delhi, Rs. 349.72 crores ! To this extent then the reported commercial loss of the SEBs, attributed to the so-called unit-cost-unrecoverable AR, turns out to be nothing but inefficiency-caused loss. If we allow for the expenses capitalized, then the total cost in the accounting sense would still decline and commercial profit increase. And the vociferous arguments and assertions for steep rises in tariff rates, proposed to be required to contain the increasing supply costs in order to save the SEBs from the red, reduces to calculated camoufaging of pampered inefficiency.

However, this is not meant to justify the present unscientific tariff setting. A rational tariff structuring should, among others, aim to help the SEB earn a reasonable return over and above the total costs, that differ at different voltage levels, once the effect of distribution loss factor also is accounted for. Thus, for example, at the LV distribution level, sufficient weight in terms of the actual distribution loss experienced should be put on the cost of supply of electricity that includes revenue expenditure and the fixed costs. This then gives, for instance, an average tariff of Rs. 2.06/unit for 1997-98, with our estimated supply cost of Rs. 1.52/unit, a mark-up of 15 per cent and a T & D loss of 15 per cent. This is greater than the AR realized in 1997-98 by 21.51 paise/unit. For Kerala, such an average tariff estimated would be Rs. 1.47/unit, higher by 22.75 paise/unit than the actual AR realized, and for Delhi, Rs. 3.03/unit, higher by 37.86 paise/unit. While all the LV consumers are logically expected to bear this charge, the HV-EHV industrial consumers need to pay much less, as supply of electricity to them involves lower unit cost of supply as well as T & D loss.

Unlike such historical (accounting) cost method generally practiced, a rational tariff policy would require charging the consumers for the actual cost of service to them. The average price structured in such a truly cost-reflecting tariff would be the long run marginal cost to the system.

Cost of the 'Cover Up'

Indeed, subsidization also involves problems of inefficiency. However, the reported loss due to subsidized power sales to agriculture in India is a substantially over-estimated one, in view of our earlier explanation on leaving agricultural energy consumption as a residual estimate. We have found that about 30 to 40 per cent of what is usually reported as agricultural power consumption in fact represents

Table 16: Unit Cost Savings From Efficiency Improvement (Paise/Unit)

	INDIA		KERALA	
	Ps/unit	%	Ps/unit	%
1. Reported unit cost of power supply in 1997-98	227.89	100.00	192.14	100.00
2. Cost savings obtainable				
(i) in power purchase, from operational efficiency improvement	49.72	21.82	40.32	20.98
(ii) in establishment & administration, from reduction in over-manning	11.05	4.85	19.78	10.29
(iii) in interest payments, from introduction of 1:1 debt-equity ratio	14.85	6.52	23.13	12.04
3. Total cost savings possible	75.62	33.18	83.23	43.32
4. 'Efficient' unit cost of power supply	152.27	66.82	108.91	56.68
5. Average revenue realized in 1997-98	184.50	80.96 (121.17)	124.60	64.8 (114.41)
6. Unit commercial profit realizable	32.23		15.69	
7. Electricity sold in 1997-98 (MU)	293479		7715.50	
8. Commercial profit realizable (Rs. Million)	94588.25		1210.60	

Note: Figures in brackets are ratio of average revenue to 'efficient' unit cost.

unaccounted-for energy. Now assuming, quite reasonably, that the actual agricultural consumption is only 65 per cent of the reported one, we can estimate the commercial 'loss', due to subsidized sales of 57,707 MU of electricity (instead of the reported 88,780 MU) to agriculture at a unit cost-revenue margin of 197.47 paise/unit in 1997-98, to be Rs. 11,395.4 crores, instead of the given Rs. 17,531.3 crores. The total effective subsidy provided to both agriculture and domestic sector would then be Rs. 16,080.4 crores, and accounting for cross subsidy and subsidy from the State Government, the 'loss' due to subsidized power sale would turn out to be only Rs. 1,084.3 crores, instead of the reported Rs. 7,220.6 crores. Thus, a good part of the huge amount of 'subsidy' claimed to be provided to agriculture, the slogan of which in turn is used unfairly to enhance the populist image of the Governments, does in fact represent the cost of inefficiency in not operating and maintaining the T & D system properly.

But the story is not yet complete; we have not counted the course of the 35 per cent of the agricultural consumption liberated as above from misclassification. Let this be available for sales instead of being thieved away. And with the heroic assumption that consumption is satisfied at the given level of 2,93,478.9 MU (in 1997-98), and that the operational efficiency, as explained earlier, has already brought down power purchase requirement to (1,74,373.9 – 1,05,186.4 =) 69,187.5 MU, we can have a further reduction in power purchase cost, using the 35 per cent recovered energy equivalent to 31,073 MU, to the tune of Rs. 4,310.14 crores or 14.69 paise per unit sold, that represents the cost of the 'cover up' (of energy theft by misreporting it as agricultural consumption). This will reduce the 'efficient' unit cost of power supply further to Rs. 1.38/unit, from the reported cost of Rs. 2.28/unit, with a cost inefficiency[18] of about 40 per cent ! Comparing this with the AR realized in 1997-98 would yield a commercial profit of Rs. 13,770 crores!

As an alternative scenario (in our flight of imagination), let this 35 per cent retrieved energy be made available for additional sale to, say, industrial and commercial sectors. Then at a cost-revenue margin of 103.65 paise per unit in 1997-98, this would bring in an additional cross-subsidy of Rs. 3,220.7 crores, taking the total cross subsidy plus State Government subvention to Rs. 18,216.4 crores, in excess of the 'actual' effective subsidy (we obtained above) to agriculture and domestic sectors of Rs. 16,080.4 crores. There is thus a commercial profit (Rs. 2,136 crores) due to (cross) subsidization ! This means that the cost, from this perspective, of the 'cover up' alone comes out to be Rs. (7,220.6 + 2,136=) 9,356.6 crores ! The question now echoes: Should the cost of this inefficiency be transferred on to the public ?

Though the real subsidy reaching the agriculture sector flows into the vast fields of big kulaks, the powerful and embedded socio-political sentiments guard and guarantee the practice of backing the backbone of the economy. Many studies have given the lie to the illusion of power subsidy to agriculture; for example, it has been found that in Maharashtra (with the discriminatory tariff) the primary beneficiaries of subsidized power in agriculture are the 5 per cent of affluent farmers growing water-intensive cash crops such as sugarcane, not the majority of poor farmers of food crops (Sant and Dixit 1996). The general profile may not be different from this case. This subsidized unmetered power consumption, though heavily cross-subsidized by the commercial and industrial customers, has, however, given the Governments an easy and costless access to vast vote banks, but at the cost of the financial health of the SEBs in the absence of any comparable compensation.

Unlike agricultural sector, however, little economic justification is found in subsidizing the domestic sector as a whole (supply to which typically imposes higher costs on the system in terms of peak time requirements, extensive distribution network, and losses). The fact that in general the unelectrified households belong to the poorest of the society questions the justification, if any, of such subsidy to this sector, that too across the board. Social and welfare regards would require special treatment to low income groups by means of a 'life-line tariff' applied to the lowest consumption slab only. Cross subsidization required should be tapped from other consumers in the same (domestic) sector, such that the sector as a whole remains subsidy-cost-free.

Internal Resources

It should be stressed that the performance of the SEBs was largely determined for a long time by the assertions and defenses of their statutorily intended promotional role in power development. The SEBs were to subserve the socio-economic policies of the State and hence expected not to view every aspect of developmental activities exclusively from the point of view of profit or return, as highlighted by the Venkataraman Committee of 1964. Thus there was no compulsive requirement, till the late seventies (till the 1978 amendment of the Section 59 of the E(S) Act, 1948), for the SEBs to break even, as also even to provide for full depreciation and/or interest payable on Government loans, both of which could, under the Statute, be provided for only if there were adequate surpluses after meeting all other obligations. Thus there seemed to be no idea, let alone requirement, of the SEBs contributing internal resources to expansion programs. The SEBs have not yet come out of that spell of unaccountable, non-commercial performance, and in general continue to have negative internal resources.

Net internal resource (NIR) refers to the surplus left with the SEBs after meeting revenue expenditure and loan repayment obligations. It thus includes operating surplus, depreciation and subvention from State Government. In line with the tradition, the NIR of the SEBs slided down from Rs (–) 162 crores in 1992-93 to Rs (–) 373 crores in 1997-98. Maharashtra was the only State to report positive NIR in all these years, and Bihar, Delhi, and West Bengal, negative NIR. Note that the actual resource generation might be much less, as revenue outstandings are high and on the increase. Further, redemption of capital loans might eat substantially into the surplus.

The NIR available with the SEBs could be increased if they were allowed to retain with them the State electricity duty (SED), collected by the SEBs and passed on to the respective State exchequer. The SED collections increased from Rs. 1,131 crores in 1992-93 to Rs. 2,365 crores in 1997-98. Gujarat has had the highest SED collection – about 37 per cent of the total in 1997-98; followed by Madhya Pradesh (16 per cent), Maharashtra (12.8 per cent), Karnataka (5.8 per cent) and Punjab (4.6 per cent). The average incidence of SED on the sale of electricity was in the range of 5 to 8 paise/unit in the 90s, or nearly 5 per cent of the estimated overall tariff for electricity sales. Provision for retention of SED with the SEBs would have left them with substantial positive NIR in all these years, except in 1997-98[19].

Before concluding, let us reiterate that lapses in financial discipline and accountability penalize the system heavily. For an instance from Kerala, consider the following observations by the Accountant General on the KSEB:

"(i) Loss due to investment of borrowed funds on short-term deposits: Rs. 27.55 lakhs;

(ii) Loss due to payment of penal interest towards non-submission of statement to banks: Rs. 13.64 lakhs;

(iii) Loss due to failure of the Board to detect the wrong transfer of funds: Rs. 3.85 lakhs;

(iv) Loss due to payment of penal interest, liquidated damages, etc., due to belated payment of principal and interest to LIC of India: Rs. 74.99 lakhs." (quoted in Government of Kerala 1997: 56)

6. Conclusion

As in the case of other infrastructure facilities with high capital intensity and long gestation period, the responsibility of power development also was originally shouldered by the Government. And in turn, the power sector was expected to subserve the social, political and economic policies of the State, even though the SEBs were required by the E(S) Act, 1948, to function as autonomous corporations. The patronizing policies of the State resulted in excessive employment, especially at the non-technical, administrative level, involving unwarranted cost increases and in irrational pricing practices for subsidized power sales, irrespective of considerations of costs, leading to substantial losses. In addition to Plan outlays allocated to the power sector, Government subventions were also on the way in, such that the SEBs never felt the pressing requirement to break even or to contribute to capacity expansion programs. The unaccountability culture, thus engendered and encouraged, permeated the whole institutional texture, and the consequent gross inefficiency contagioned the system. The rot set in. Losses mounted up, and prospects counted down. And then one fine day, the Government awakened to the bitter truth that its coffer could no longer contain such losses, and exhorted and enjoined the SEBs to mend their ways and mind their means. Then followed the pandemonium, the chaos that is to precede any restructruring. By that time, however, the lot had been cast.

The whole system could be spared from such avoidable chaos, if the Government interference were kept to a minimum and the SEBs were let to function as autonomous commercial-cum-service corporations, as required by the E(S) Act. We have seen that if some minimum, affordable standards of efficiency were maintained at the technical, and institutional/organizational levels in the functioning of the SEBs, considerable cost savings could be achieved and this, coupled with a rational pricing practice, could win the system a very comfortable position. It could work even otherwise; if the Government fully compensated the SEBs for its induced inefficiencies regularly and in time, the industry could still sustain its survivability[20] . The compensation system has failed on both the fronts – the timely submission of the accounts by the SEBs and the timely payment by the Government. Here is an instance: 'The rural electrification subsidy receivable from the Government of Kerala for the loss incurred by the KSEB due to Rural Electrification operations during 1985-86 to 1993-94 was estimated and submitted to the Government for sanctioning the release of subsidy' only by 1996-97 (KSEB, *Annual Statement of Accounts 1996-97 and 1997-98*). When will these accounts now hatch ?

The utter negligence and neglect of the means to ensure minimum T & D loss has been another contaminated fallout of the Government-sponsored inefficiency. Unmetered drawal of electricity is rampant in several urban areas, in connivance with the Board staff, or by errant consumers enjoying protective patronage. The Union Power Minister has recently dubbed this unaccountable-for energy as "theft and dacoity losses", amounting to about Rs. 15,000 crores every year. 'He gave the example of Orissa, where the private sector companies that have taken over distribution of electricity are finding it difficult even to install meters, what to speak of collecting the dues. "AES of USA is having to employ goon gangs to install meters", the Minister said.' (*The Hindu Business Line*, March 31, 2000). Isn't the reform process initiated in Orissa then a reflection of the defeated political will at the hands of a Frankenstein ?

Compounding all these is the infamous X-inefficiency at all levels of 'work culture', that has deteriorated to such an abyss that it remains devoid of any accountability, a legacy of the original sin of service-only-orientation forced on the SEBs. It may not be unreasonable to state that this is in fact basic and central to many problems in the electricity supply industry in India. And inefficiency continues to rot the system, the inefficiency bred and fed by a host of factors at technical, institutional and organizational, financial as well as socio-political policy levels. However, the most relieving aspect of this system predicament is that the problems are just internal to the system, as we have shown above[21] . This then implies that there do remain sufficient quarters for remedial exercises, meant to remove the problems that stand in the way of the SEBs' improved performance. In other words, what the system badly requires is essence-specific reforms, not structure-specific ones.

The parlous financial position of the SEBs has come in handy for the institutional lenders including the World Bank to press for structure-specific reforms. The attraction of soft loans offered as a package with reforms and of the selling out of public sector assets have cornered and captured the political theory of corruption that governs the prodigal governments. The result resembles an irreversible, disastrous Alexanderian solution to the Gordian knot – the so-called reforms now under way in a number of States which in practice will remain incapable of addressing the real problems internal to the system. Will a forced change of the *form* transmute the *substance* also ?

"Light is sorrow, my son;
Isn't darkness a pleasant one ?"

- Akkitham (Malayalam poet)

Notes

1 It should be clarified at the outset itself that power sector performance evaluation has some unique features in that efficiency considerations *need not* follow the beaten econometric/mathematical programming track. In standard economic text books, 'efficiency' is exclusively referred to as allocative efficiency - the production of the 'best' or 'optimal' level of output by means of the most efficient combination of inputs. With this definition, then, the distance between the 'optimal' or maximum output and the actual output indicates the inefficiency involved in production. That is, the efficiency rating of a production process = (actual output/ maximum output). "Optimal' or maximum output might be determined in various ways – through economic or programming techniques. However, "When capital equipment is capacity rated in terms of output units, as in electricity generation, one can measure directly the denominator" in the above equation [Betancourt 1987: 369-370] and the short-run capacity (and hence capital) utilization and efficiency measure coincide. Given this simple method of utmost clarity and accessible interpretations, it is not worth indulging oneself in such econometric exercises as constrained by the never-conclusive capital controversy, for one thing, except as an academic fascination. Hence, in what follows, we analyse power sector efficiency in the usual sense as it is employed in electricity economics.

2 The Ninth Plan envisages a prioritization of hydro-electric power development, targeting an addition of 9,820 MW of hydro capacity, in order to rectify the prevailing imbalance in the hydro-thermal mix. It should be noted that inadequate hydel support in the Western and Eastern regions adversely affects the performance of the thermal plants, as they are uneconomically used to provide only the peaking power, thus having to be backed down during the off-peak hours.

3 There can also be some partial outages due to internal constraints of the deficiency in achieving full rating of the units either in equipment or in auxiliaries, and also/ or due to external constraints such as shortage of fuel and coolant or absence of adequate power evacuating capacity.

4 It is estimated that there are about 117 thermal units of 11,000 MW (out of a total thermal capacity of about 59,000 MW) that have already completed more than 20 years of their useful design life (of 25 years); about 50 per cent of these stations operate at less than 45 per cent PLF. Similarly, there are about 35 hydro power stations that have been in operation for over 30 years in excess of their useful operating life (Government of India 2000: 19-20).

5 The fluidized bed boiler design of these larger plants provides much higher efficiency of combustion than the conventional manual or stroker firing, thus reducing the quantity of fuel required. Moreover, it maintains a low fuel bed temperature preventing the formation of lumps of molten ash, a regular problem with the combustion of Indian coal of high ash content. Note that in this light the increased PLF may be taken as not so much of better performance as of partial adoption of a technological progress

6 Acceptance and adoption of PLF as a general criterion of plant performance efficiency can have adverse effects in certain circumstances, as when units are to back down for want of adequate system load. In fact, the practice of linking employee bonus schemes to the PLF attained by the corresponding plants is

identified as one of the factors contributing to aggravating grid indiscipline. It should be noted that availability is the internationally accepted measure of plant efficiency.

7 Both the invariable location-specificity of the hydro-power plants and the economies in developing pithead-based thermal stations (as transportation of coal has been found to be less economical than transmission of an equivalent amount of electric power over long distances) necessitate extensive network of transmission lines. Also there are economies in interconnecting different power stations as well as systems in an electric Grid.

8 The Indian Electricity Act, 1910 was amended (in 1986) through Sections 39 and 39A to make theft of energy and its abetment a cognizable offence with deterrent punishment of up to three years imprisonment.

9 That the agricultural consumption of power in India is highly doctored, due to its being a 'residual' in estimation, is now a widely acknowledged fact; in the States, where the power sector has been restructured, the regulators, in recognition of this 'misclassification', have revised upwards the T & D loss percentages – for example, in Orissa, from 23 per cent before restructuring to 51 per cent post-reform; in Andhra Pradesh, from 25 per cent to 45 per cent, in Haryana, from 32 per cent to 40 per cent, and in Rajasthan, from 26 per cent to 43 per cent (Government of India 2000: 35; also see Morris 2000, and Rao 2000).

10 The savings in T & D reduction could as well lead to an increase in energy sales (to, say, the industrial sector, that suffers the most from power shortage) and thus in revenue, instead of helping to cut down energy import and thus supply cost.

11 In 1997-98, remember, 4 SEBs had more than 88 per cent availability and 3 SEBs had more than 75 per cent PLF.

12 This is because the PPA is in general designed for a base load plant only, which is permitted to generate at full load whenever possible. The 1992 Notification, issued in the wake of the 1991 opening up policy, does endorse such a costly design. This commitment requires backing down of the existing cheaper power stations during off-peak periods and monsoon season, causing uneconomic plant dispatch, i.e., low unit cost power being replaced by high cost power (also see World Bank 1995: 84, and D'Sa, et al. 1999).

13 Maharashtra SEB also faces a similar problem of 'systemic inefficiency' due to uneconomic 'merit' order, thanks to its PPA with Enron. Honouring the PPA (at Rs. 4.50 per unit of Enron power) costs the MSEB a good part of the cheaper power from Tata Electric Power as well as from its own thermal power plants with costs around a fourth of Enron power (*The Hindu Business Line*, July 11, 2000).

14 Rajadhyaksha Committee on Power (1980) observes on this aspect: "Besides low tariffs, the causes of the poor financial performance are the low operating efficiencies, high capital cost of projects due to long delays in construction and high overheads – mainly the result of heavy overstaffing. Although precise comparisons are not possible, the average employees per MW of installed capacity in India is 7 compared to 1.2 in the USA, 1.5 in Japan and 1.7 in the UK. Within the country, the expenditure on salaries varies from 12 per cent to 40 per cent of

the total income of the SEBs. Much of this overstaffing is due to SEBs being compelled under political pressures to take on people they do not need." (Government of India 1980: 53).

15 Another solution comes from raising the available internal resources, through, say, prompt collection of revenue arrears that could substantially reduce loan requirements. This aspect we will consider shortly.

16 It should be pointed out here that courts have upheld the validity of the power of the Government to fix tariff rates (e.g., 1988 (1) K. L. T. 727; 1987 (1) KLT 777; 1978 KLT 613; AIR 1960 SC, 610; 1984 SC 170 etc.). "It is true that the Board is the primary authority to fix electricity tariff rates. But, there is a statutory power reserved in favour of the Government under Section 22-B to issue, when conditions exist, necessary orders to ensure equitable distribution of electrical energy. When the power is so exercised by the Government, it can also fix the tariff rates, for, the fixation of tariff rates is incidental to the power to regulate supply, distribution, and consumption and use of electrical energy and is also part of the regulatory process of equitable distribution of electrical energy. The Government is free to make their own classification of consumers for fixation of different rates of electricity tariff and they are not bound by the specification, categorisation, designation or division made by the Board for purposes of levying electricity charges." (1988 (1) KLT 727, Social S. G. of Assisi Sisters *vs.* KSEB, para. 7)

17 Hopkinson rate, popularly known as maximum demand tariff or two-part tariff, includes a (fixed) demand charge per period based on maximum demand and a variable charge based on actual energy consumption. The English engineer Dr. John Hopkinson is considered the grandfather of electricity rate making.

18 Note that this aspect of inefficiency we have not included in Table 16.

19 Note that the legal validity of SED is in fact under question. The Kerala High Court has opined: "….the surcharge imposed adds to the revenue of the State and surcharge order is a fiscal measure intended to augment the financial resources of the State…It was argued that under Section 63 of the Electricity (Supply) Act, the State Government may make subventions to the Board and this surcharge is deemed to enable the Government to make subventions. Section 63 does not authorise the Government to raise its revenue from the consumers of electric energy to enable it to make subventions to the Board. Under Section 63, there is no obligation on the Government to make any subvention and the grant is "entirely on the bounty of the Governhment"…If the action was that the Board should be benefitted by this surcharge, there was no necessity for the Government to collect the same and them make subvention to the Board." [1988 (2) KLT 680, Chakolas Spinning and Weaving Mills Ltd. Vs. KSEB, paras 9, 24 and 25].

20 This, however, rests on the assumption that the SEBs do not tend to make unfair use of the compensation facility by laying their own inefficiencies in the exchequer's net.

21 Committees after Committees have already identified these problems and prescribed remedies, the timely adoption and execution of which would have spared the system from the present predicament.

References

Betancourt, (1987).'Capital Utilization', *The New Palgrave A Dictionary of Economics*. pp. 368-370. Macmillan, Cambridge, Massachusetts.

Council of Power Utilities (1997). *Salient Features of Electricity Generation, Capacity and Consumption in Some Countries*, January. New Delhi.

D'Sa, Antonette, Murthy, K. V. N., and Reddy, A. K. N. (1999). 'India's Power Sector Liberalization: An Overview', *Economic and Political Weekly*, June 5, pp. 1427-1434.

Government of India (1964). *Report of the High Level Committee on Power*. Ministry of irrigation and Power, New Delhi.

Government of India (1980). *Report of the Committee on Power*. Ministry of Energy, Department of Power, New Delhi.

Government of India (1996-97). *Public Electricity Supply, All India Statistics, General Review*, CEA, New Delhi.

Government of India (1999). *Annual Report of the Working of SEBs and EDs*, April, Planning Commission, New Delhi.

Governemnt of India (2000). *Conference of Power Ministers: Agenda Notes*. 26 February, Ministry of Power, New Delhi.

Government of Kerala, *Economic Review*, (different volumes), State Planning Board, Thiruvananthapuram.

Government of Kerala (1984). *Report of the High Level Committee on Industry, Trade and Power, Vol. III, Report on Power Development*, State Planning Board, Trivandrum.

Government of Kerala (1997). *Report of the E. Balanandan Committee to Study the Development of Electricity*. February.

Government of Kerala (1998). *Organizational Self-Assessment: Reports of the Working Groups – Discussion Paper*, KSEB and EISP, Thiruvananthapuram.

Kerala State Electricity Board, *Power System Statistics* (different volumes), Thiruvananthapuram.

Kerala State Electricity Board, *Annual Administration Report* (different volumes), Thiruvananthapuram.

Kerala State Electricity Board, *Annual Statement of Accounts* (different volumes), Thiruvananthapuram.

Leibenstein, H., (1976). *Beyond Economic Man – A New Foundation for Microeconomics*, Harvard University Press, Massachusetts.

Morris, Sebastian (2000). 'Regulatory Strategy and Restructuring: Model for Gujarat Power Sector', *Economic and Political Weekly*, June 3, pp. 1915-1929.

Pillai, Vijayamohanan (1991). *Seasonal Time-of-Day Pricing of Electricity Under Uncertainty – A Marginalist Approach to Kerala Power System*. Unpublished Ph. D. Thesis. University of Madras, Chennai.

Pillai, Vijayamohanan (1999) 'Reliability Analysis of a Power Generation System: A Case Study', *Productivity*, July – September, pp. 310-318.

Rao, M. Govinda, Shand, R. T., and Kalirajan, K. P. (1998-99). 'State Electricity Boards: A Performance Evaluation', *The Indian Economic Journal,* Vol. 46 (2), October-December.

Rao, S. L. (2000). 'Electricity Reform and Regulation: Some Issues', *Economic and Political Weekly*, June 24, pp. 2231-2234.

Sant, Girish and Dixit, Shantanu (1996) 'Beneficiaries of IPs Subsidy and Impact of Tariff Hike' *Economic and Political Weekly*, Vol. 31, No. 15, December 21.

Shah, C. M., Dalal, C. M., and Patel, K. H. (1985). 'Minimization of Losses in Power System – A Case Study of Reduction of Distribution Losses from 16 % to 10 %' *Irrigation and Power Journal*, Vol. 42 (3), pp. 275 – 284.

World Bank (1995). *Economic Developments in India: Achievements and Challenges*, World Bank country study, Washington D.C.

Zachariah, K. C., et al. (1999). *Migration in Kerala State, India: Dimensions, Determinants and Consequences*, (mimeo) Centre for Development Studies, Thiruvananthapuram.

CENTRE FOR DEVELOPMENT STUDIES
LIST OF WORKING PAPERS

(From 1991 onwards)

MRIDUL EAPEN Hantex: An Economic Appraisal.
September, 1991, W.P.242

SUNIL MANI Government Intervention in Commercial Crop Development: A Case of Flue Cured Virginia Tobacco.
November, 1991, W.P.243

K. PUSHPANGADAN Wage Determination in a Casual Labour Market: The Case Study of Paddy Field Labour in Kerala.
January, 1992, W.P.244

K.N. NAIR & S.P. PADHI Dynamics of Land Distribution: An Alternative Approach and Analysis with Reference to Kerala.
January, 1992, W.P.245

THOMAS ISAAC Estimates of External Trade Flows of Kerala - 1975-76 and 1980-81.
March, 1992, W.P.246

THOMAS ISAAC, RAM MANOHAR REDDY, NATA DUVVURRY Regional Terms of Trade for the State of Kerala.
March, 1992, W.P.247

P. MOHANAN PILLAI Constraints on the Diffusion of Innovations in Kerala: A Case Study of Smokeless Chulas.
March, 1992, W.P.248

R. ANANDRAJ Cyclicality in Industrial Growth in India: An Exploratory Analysis.
April, 1992, W.P.249

T.M. THOMAS ISAAC, RAM MANOHAR REDDY, NATA DUVVURY Balance of Trade, Remittance and Net Capital Flows: An Analysis of Economic Development in Kerala since independence.
October, 1992, W.P.250

M. KABIR, T.N. KRISHNAN Social Intermediation and Health Transition: Lessons from Kerala,
October, 1992, W.P.251

SUNIL MANI, P. NANDAKUMAR Aggregate Net Financial Flows to India: The Relative Importance of Private Loan vis-a-vis Foreign Direct Investments.
August, 1993, W.P.252

PULAPRE BALAKRISHNAN Rationale and the Result of the Current Stabilisation Programme.
November, 1993, W.P.253

K.K. SUBRAHMANIAN, P. MOHANAN PILLAI Modern Small Industry in Kerala: A Review of Structural Change and Growth Performance.
January, 1994, W.P.254

DILIP M.MENON Becoming Hindu and Muslim : Identity and Conflict in Malabar 1900-1936.
January, 1994, W.P.255

D. NARAYANA Government Intervention in Commodity Trade: An Analysis of the Coffee Trade in India.
January, 1994, W.P.256

K.J. JOSEPH, P. NANDAKUMAR On the Determinants of Current Account Deficits: A Comparative Analysis of India, China and South Korea.
January, 1994, W.P.257

K.K. SUBRAHMANIAN, K.J. JOSEPH Foreign Control and Export Intensity of Firms in Indian Industry.
February, 1994, W.P.258

PULAPRE BALAKRISHNAN, K. PUSHPANGADAN Total Factor Productivity Growth in Indian Manufacturing - A Fresh Look.
April 1994, W.P.259

D. NARAYANA, K.N. NAIR Role of the Leading Input in Shaping Institutions: Tendency in the Context of Irrigation Uncertainty.
May, 1994, W.P.260

G. MURUGAN, K. PUSHPANGADAN Pricing of Drinking Water: An Application of Coase Two-part Tariff.
December, 1994 W.P.261

MOHANAN PILLAI On the Mexican Crisis.
December, 1995, W.P.262

SUNIL MANI Financing Domestic Technology Development through the Venture Capital Route.
December, 1995, W.P.263

T.T. SREEKUMAR Peasants and Formal Credit in Thiruvithamcore: The State Institutions and Social Structure 1914-1940.
December, 1995 W.P.264

AMITABH Estimation of the Affordability of Land for Housing Purposes in Lucknow City, Uttar Pradesh (India): 1970-1990.
March, 1996. W.P.265

K. PUSHPANGADAN, G. MURUGAN, K. NAVANEETHAM Travel Time, User Rate & Cost of Supply: Drinking Water in Kerala, India:
June 1996. W.P.266

K.J. JOSEPH Structural Adjustment in India: A Survey of Recent Studies & Issues for Further Research,
June 1996 W.P.267

D. NARAYANA Asian Fertility Transition: Is Gender Equity in Formal Occupations an Explanatory Factor?
October, 1996 W.P.268

D. NARAYANA, SAIKAT SINHAROY Import and Domestic Production of Capital Goods from Substitution to Complementarity,
October 1996. W.P.269

NEW SERIES

W.P. 270 **ACHIN CHAKRABORTY** *On the Possibility of a Weighting System for Functionings* December 1996

W.P. 271 **SRIJIT MISHRA** *Production and Grain Drain in two inland Regions of Orissa* December 1996

W.P. 272 **SUNIL MANI** *Divestment and Public Sector Enterprise Reforms, Indian Experience Since 1991* February 1997

W.P. 273 **ROBERT E. EVENSON, K.J. JOSEPH** *Foreign Technology Licensing in Indian Industry : An econometric analysis of the choice of partners, terms of contract and the effect on licensees' performance* March 1997

W.P. 274 **K. PUSHPANGADAN, G. MURUGAN** *User Financing & Collective action: Relevance sustainable Rural water supply in India.* March 1997.

W.P. 275 **G. OMKARNATH** *Capabilities and the process of Development* March 1997

W. P. 276 **V. SANTHAKUMAR** *Institutional Lock-in in Natural Resource Management: The Case of Water Resources in Kerala,* April 1997.

W. P. 277 **PRADEEP KUMAR PANDA** *Living Arrangements of the Elderly in Rural Orissa,* May 1997.

W. P. 278 **PRADEEP KUMAR PANDA** *The Effects of Safe Drinking Water and Sanitation on Diarrhoeal Diseases Among Children in Rural Orissa,* May 1997.

W.P. 279 **U.S. MISRA, MALA RAMANATHAN, S. IRUDAYA RAJAN** Induced Abortion Potential Among Indian Women, August 1997.

W.P. 280 **PRADEEP KUMAR PANDA** *Female Headship, Poverty and Child Welfare : A Study of Rural Orissa, India,* August 1997.

W.P. 281 **SUNIL MANI** *Government Intervention in Industrial R & D, Some Lessons from the International Experience for India,* August 1997.

W.P. 282 **S. IRUDAYA RAJAN, K. C. ZACHARIAH** *Long Term Implications of Low Fertility in Kerala,* October 1997.

W.P. 283 **INDRANI CHAKRABORTY** *Living Standard and Economic Growth: A fresh Look at the Relationship Through the Non- Parametric Approach,* October 1997.

W.P. 284 **K. P. KANNAN** *Political Economy of Labour and Development in Kerala,* January 1998.

W.P. 285 **V. SANTHAKUMAR** *Inefficiency and Institutional Issues in the Provision of Merit Goods,* February 1998.

W.P. 286 **ACHIN CHAKRABORTY** *The Irrelevance of Methodology and the Art of the Possible : Reading Sen and Hirschman,* February 1998.

W.P. 287 **K. PUSHPANGADAN, G. MURUGAN** *Pricing with Changing Welfare Criterion: An Application of Ramsey- Wilson Model to Urban Water Supply,* March 1998.

W.P. 288 **S. SUDHA, S. IRUDAYA RAJAN** *Intensifying Masculinity of Sex Ratios in India : New Evidence 1981-1991,* May 1998.

W.P. 289 **JOHN KURIEN** *Small Scale Fisheries in the Context of Globalisation,* October 1998.

W.P. 290 **CHRISTOPHE Z. GUILMOTO, S. IRUDAYA RAJAN** *Regional Heterogeneity and Fertility Behaviour in India,* November 1998.

W.P. 291 **P. K. MICHAEL THARAKAN** *Coffee, Tea or Pepper? Factors Affecting Choice of Crops by Agro-Entrepreneurs in Nineteenth Century South-West India,* November 1998

W.P. 292 **PRADEEP KUMAR PANDA** *Poverty and young Women's Employment: Linkages in Kerala,* February, 1999.

W.P. 293 **MRIDUL EAPEN** *Economic Diversification In Kerala : A Spatial Analysis,* April, 1999.

W.P. 294 **K. P. KANNAN** *Poverty Alleviation as Advancing Basic Human Capabilities: Kerala's Achievements Compared,* May, 1999.

W.P. 295 **N. SHANTA AND J. DENNIS RAJA KUMAR** *Corporate Statistics: The Missing Numbers,* May, 1999.

W.P. 296 **P.K. MICHAEL THARAKAN AND K. NAVANEETHAM** *Population Projection and Policy Implications for Education:A Discussion with Reference to Kerala,* July, 1999.

W.P. 297 **K.C. ZACHARIAH, E. T. MATHEW, S. IRUDAYA RAJAN** *Impact of Migration on Kerala's Economy and Society,* July, 1999.

W.P. 298 **D. NARAYANA, K. K. HARI KURUP,** *Decentralisation of the Health Care Sector in Kerala : Some Issues,* January, 2000.

W.P. 299 **JOHN KURIEN** *Factoring Social and Cultural Dimensions into Food and Livelihood Security Issues of Marine Fisheries; A Case Study of Kerala State, India,* February, 2000.

W.P. 300 **D. NARAYANA** *Banking Sector Reforms and the Emerging Inequalities in Commercial Credit Deployment in India,* March, 2000.

W.P. 301 **P. L. BEENA** *An Analysis of Mergers in the Private Corporate Sector in India,* March, 2000.

W.P. 302 **K. PUSHPANGADAN, G. MURUGAN,** *Gender Bias in a Marginalised Community: A Study of Fisherfolk in Coastal Kerala,* May 2000.

W.P. 303 **K. C. ZACHARIAH, E. T. MATHEW, S. IRUDAYA RAJAN ,** *Socio-Economic and Demographic Consequenes of Migration in Kerala,* May 2000.

W.P. 304 **K. P. KANNAN,** *Food Security in a Regional Perspective; A View from 'Food Deficit' Kerala,* July 2000.

W.P. 305 **K. N. HARILAL, K.J. JOSEPH,** *Stagnation and Revival of Kerala Economy: An Open Economy Perspective,* August 2000.

W.P. 306 **S. IRUDAYA RAJAN,** *Home Away From Home: A Survey of Oldage Homes and inmates in Kerala,* August 2000.

W.P. 307 **K. NAVANEETHAM, A. DHARMALINGAM,** *Utilization of Maternal Health Care Services in South India,* October 2000.