Bottom-up Electricity Reform Using Industrial Captive Generation: A Case Study of Gujarat, India

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Abstract

Financing new electricity generation capacity has been a persistent problem in developing countries. The conventional response has been to create competitive electricity markets by encouraging new entry into the generation sector and by breaking up vertically integrated monopolies power companies. This paper argues using a case study from Gujarat, India, for an alternative approach – leverage the captive power capacity (self-generation) of industry to reshape the generation and distribution sectors from the bottom up. Captive power is well positioned to both add capacity to systems struggling to meet demand and increase competition in the power market. A bottom-up method of power reform enables capacity from independent and industrial sources, which will best harness the financial and engineering resources of the Indian electricity supply industry. The solution proposed is not put forward as an optimised policy prescription, but instead represents the best of the feasible options available within current political and economic constraints.

1. Introduction

The two-decade long history of power reforms in emerging economies has returned a mix of successes and failures. Building and financing adequate new electricity generation capacity remains a persistent problem in developing countries. To address capacity shortfalls and the lack of capital available for new units, the conventional wisdom has been to create competitive electricity markets by encouraging new entry into the generation sector and by breaking up vertically integrated monopolies power companies; all with the goal of increasing power sector efficiency and investment (Joskow 1998). What began in Chile in 1980, continued in the UK and US and then prospered as a policy direction around the world has been a top-down approach that seeks to disaggregate and privatise the generation sector and create regulated private ownership in the natural monopolies of transmission and distribution.

In this paper, an alternative approach is advanced for India – leverage the captive power capacity (self-generation) of industry to reshape the generation and distribution sectors from the bottom-up. The second section details the reasons why top-down programmes fail to meet the needs of developing markets. In Section 3, a case study from Gujarat, India is used to illustrate the shortcomings of the top-down reform model. Section 4 explains the advantages of the bottom-up model using captive power and how this approach is well positioned to add capacity to a system struggling to meet demand. The fifth section examines why more captive power plants (CPP) will increase competition in the power market. The final section details the regulatory requirements for a bottom up approach and how each policy lever has an impact on CPP economics. The paper concludes that more power from independent and industrial sources will best harness the financial and engineer resources of the Indian electricity supply industry (ESI) and ultimately benefit the economy. The solution proposed is not put forward as an optimal policy programme, but instead is advanced as the best of the feasible options available within current political and economic constraints.

2. Failure of the Top-Down Reform Model

2.1 The Standard Prescription

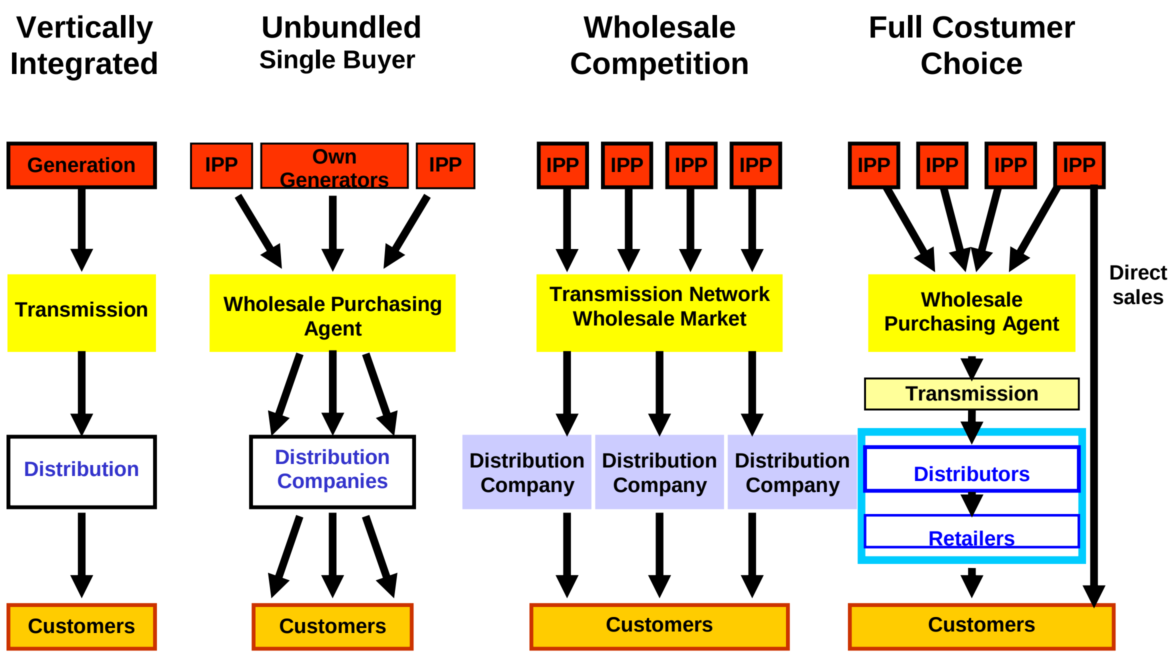
The 1990s saw a wave of power sector reform progress around the world and a number of excellent accounts of the general and country by country process are in the literature, e.g. (Thillai 2000; Bacon and Besant-Jones 2001; del Sol 2002; Joskow 2003). The common feature of many of the programmes, pushed by the World Bank, regional development banks, and many bilateral aid agencies relied upon what is known as the 'standard prescription'. The standard prescription as described by Hunt (2002) calls for:

1. Stand-alone transmission company
2. Privately-owned, competing generation companies that bid into a bulk/wholesale power pool
3. Supply competition for all or part of the retail market

4. Third-party access to transmission and distribution on non-discriminatory, transparent terms
5. Independent and transparent regulator

To achieve these goals, a staged transition from a vertically integrated, typically state-owned, monopoly to a market with full customer choice and with the price of power controlled by competition was proposed (Bacon and Besant-Jones 2001). Figure 1 represents the typical configuration of the standard model of liberalisation and its four phases.

Figure 1: Standard Prescription Model Stages (Hunt 2002)



The top-down model is difficult to implement in developing countries for a number of reasons, including both operational and technical hurdles. In the UK and US state's restructuring programmes, a number of advantageous pre-existing conditions aided the eventual transition to functional electricity markets.

First, they both had a stable, functioning transmission grid with adequate capacity and regular maintenance regime (Yi-Chong 2004). India lacks both of these and without a reliable means of moving power, the preconditions for market are not met, buyer and seller cannot get together. In addition, both the UK and US-leader California had in place surplus generation capacity at the time of transition, enabling surplus power to be traded and lent liquidity to the fledgling power exchanges (Joskow 2003). Second, the US and UK had in place high regulatory capacity, i.e. the skills and manpower to effectively regulate complex network sectors like electricity. Lack of regulatory capacity and adequate manpower, as well as lower compensation have often left new regulators understaffed and lacking adequate analytical capacity (Stern 2000). Going further, regulators in developing countries require high relative expenditures and many developing countries have struggled to build robust bodies (Purohit, Kumar et al. 2002).

The fourth criteria that is often lacking in developing countries undertaking power reforms are robust legal systems and established contract law enforcement. While India does have a well established court system, and few examples of state appropriation of assets (Joshi 2003), power sector reform have been undermined by the failed IPP model that largely fell apart in the mid-1990s after the collapse of Dabhol.

Fifth, reform requires robust distribution companies, both physically and financially. UK and US distribution systems matured in a regulated environment with a guaranteed return on capital. This lead to gold plating the investments, but as a consequence the physical systems were in excellent condition at the time of increased competition, and the distribution companies were a strong link in the system, and most of the problems stemmed from the function of the market mechanisms, not system failures in distribution. On the financial side, UK and US distributors had a solid billing and metering system in place which ensured a steady cash flow to the distributors and in turn to the power suppliers. In India, both of these conditions are absent. For example, Gujarat's transmission and distribution sectors are historically weak; and the state has a high ratio of low voltage to high-voltage transmission lines which contributes to high levels of power losses. In addition, most agriculture connections do not have meters and in some circles more than 50 percent of the power is used without payment. The lack of billing and collection systems has meant that much of the electricity brings no return or is obfuscated as agriculture load or transmission losses (Morris 2002). As a result, the GEB does not have a stable cash flow.

Sixth, prices will be restrained by allowing new entrants into the generation an supply sectors, otherwise the incumbent will dominate the liberalised market and exercise market power to raise prices to monopoly or oligopoly levels. The other option is to requiring the incumbent(s) to enter into long term forward contracts (Joskow 2003).

Finally, the reform process has worked best when demand growth is slow and controlled and when the generation and transmission sectors have excess capacity. For instance, in California and Chile, there was excess capacity in the system before the reform process was initiated (Besant-Jones and Tenenbaum 2001; Yi-Chong 2004). In situations of shortage and fast demand growth, like Gujarat, India, the introduction of a market merely reveals the capacity shortage in the form of rapid and explosive price increases, a hurdle to reform that was on display in Orissa. The market reformers at the World Bank writing about the California crisis recognised that a market cannot deliver power at reasonable prices without adequate generation capacity for both peak and base-load demand (Besant-Jones and Tenenbaum 2001).

2.2 Impact of the World Bank

The World Bank has pursued electricity sector reform in almost every country in which it operates as part of structural adjustment packages and as a key condition for further World Bank loans. In 1993, the bank formulated new policies for lending in the power sector and provided loans only to utilities which committed to reform and commercialisation. This policy has been cited as a key trigger to beginning reforms and meeting on paper the objectives (Thillai 2003), and in India took the form of pushing for unbundling, privatisation, and independent regulation. The Bank also sought to reduce government ownership and increase the amount of private capital investing in the sector though implementing cost-based pricing and elimination of cross-subsidies (Wagle 2000).

Not surprisingly, this approach has been heavily criticised for not taking into account the development objectives that are intertwined with electricity provision and an overemphasis on ownership changes without building adequate regulatory capacity to oversee the new market structures (Wamukonya 2003). Perhaps more important is what the Bank had to say about itself in July 2003 report by the Operations Evaluation Department (WB 2003):

1. The Bank "underestimated the complexity and time required for reforms to mature"
2. Private Sector Participation has not produced the desired results and "no single blueprint" is adequate for power reform. However, good results were cited when "country ownership and political commitment exists"
3. In India and other developing countries, "strategic investors have withdrawn from the sector in droves"
4. The Bank's technocratic view did not give "adequate weight to the political economy of reform and proved too optimistic"
5. Concluded that the single-buyer model not effective

This honest appraisal may be considered a *mea culpa* on the part of the Bank, but it also shows the need for a careful understanding of the starting positions of each country and how important phasing is for reform efforts. India has been heavily influenced by the Bank's efforts throughout the 1990s and continues to take funds to pay for restructuring and regulatory studies, as well as incentives for SEB which improve performance. For example, from 1996 to 2001, five state governments signed loan agreements for more than $900 million with the World Bank (Wamukonya 2003). The biggest of those was Orissa in 1996, where the first implementation of the standard reform model in India was undertaken.

2.3 World Bank in India: Orissa Electricity Reform

The first implementation of the standard reform model in India was in the eastern state of Orissa, which began the formal reform process with corporatisation of the SEB, passage of an electricity law and restructuring generation, transmission and distribution in 1995. The total power sector restructuring project cost was a formidable $997 million, of which $350 million came from a World Bank loan. The Asian Development Bank (ADB) and the UK's Department for International Development (DfID) and several leading international management consultants were also heavily involved.

One of the main reasons that Orissa was ripe for restructuring compared with other Indian states is that the chief minister Biju Pattnaik was committed to the project and many observers believe that the reform would not have passed without his sponsorship (Thillai 2000). However, Orissa was also a special case among Indian states in that it had only 5.7 percent of consumption from agriculture (vs. India average of 30 percent) in 1994 due to the low penetration of electric pumpsets for irrigation in the state. Coupled with the weakness of the SEB unions in Orissa, this made it much easier politically to change the sector.

The reform programme used a top-down restructuring method, in other words, took the incumbent utility and divided its assets into competing entities through a process of unbundling and corporatisation (Ramanathan and Hasan 2003). In distribution, the OSEB was divided into four geographical zones and a contract was signed with a private operator, Bombay Suburban Electricity Supply (BSES) to manage the central distribution zone. However, the contract was cancelled by the Grid Corporation in 1997 and instead the four zones were opened up to private investment by selling 51 percent of equity (Thillai 2003). By 1999, three of the four privatised DistCos were sold to one buyer and in generation only partial privatisation occurred with the entry of American firm AES as an IPP with a long-term contract to the single buyer. The process involved a large number of high-cost, mostly foreign consultants to design the blueprint for reforms at a total cost of more than $85 million.

In effect, Orissa adopted the so called "single buyer" version of top-down reform, which has "inherent limitations" for creating competition (Ramanathan and Hasan 2003). The only new generation capacity added during the post-reform period (1996-2003) relied on long-term PPAs, which provided a payment guarantee and ensured that no real competition between suppliers took place. The lack of a solid metering and payment collection mechanism, as well as theft and a gap between tariffs and the cost of service, left the system bankrupt at every level. This shortfall eventually percolated up to the generators. The introduction of a segmented generation pool with few participants and power purchase guarantees for new entrants made the generation side functionally uncompetitive.

The absence of competition does not stop at generation in Orissa, as the TRANSCOs must sell to the geographical monopolies of the DISTCOs which are the only suppliers to the customers in their area. The industry structure is in a "command and control mode" and lacks both competition and customer choice (Haldea 2003). The DISTCOs continue to make large losses as payment collection efficiency has dropped. On the positive side, theft and T&D losses have marginally decreased, but have not provided the gains needed to reinvigorate investment in the sector. This experience demonstrates that the DISTCOs have not brought much needed new capital or better management to the sector , nor have they accomplished social policy goals, such as rural electrification, within the new ownership structure (Ramanathan and Hasan 2003).

The impact of the Orissa programme has been far reaching in India, with many other states following the lead and implementing some form of restructuring in its wake. Most states have now set up independent regulatory commissions and are moving to corporatise and unbundle their SEBs. The 2003 EAct aimed to accelerate the process by requiring corporatisation of all SEBs and implementation of a multi-buyer system by enabling bilateral trades, inter-state power trading and trading licensing. In generation, the act effectively delicenses the sector and grants unfettered approval for captive power plants, which is the focus of the second half of this paper. The Act has already been amended with the passage of changes in December of 2003 that limit investigative and police power for power theft and most importantly, the addition of time limits - three to five years - for SERCs to introduce open access for transmission and distribution.

This has been the case in Gujarat, where state legislation in 1998 created the GERC and a state power sector reform bills was passed almost simultaneously with the central Electricity Act of 2003. This has lead to the creation of one generation company, GESCL, one transmission company (GETCO) and five distribution companies, but all are still controlled by the GEB and the companies are separate only on paper. Implementation of the new legislation was delayed until late in 2004 and the process moved slowly to navigate the many political interest groups' demands.

2.4 New Government Initiatives in India

The flagship programme from the centre is the Accelerated Power Development Reforms Programme (APDRP), originally the (APDP), and is designed to be a carrot for states to speed up reform efforts and to infused needed capital into the distribution sector. GoI provides the funds as a 25 percent grant, 25 percent soft loan package with the remaining 50 percent raised by the SEB. The Ministry describes the goals as follows:

> "The APDRP [was implemented] from the year 2000-01 as a last means for restoring the economic viability of the Distribution Sector. Under this programme, funds would be allocated to the State Electricity Boards/Utilities/DISTCOMS who have adopted the path of Distribution reforms. Initially, 63 distribution circles have been identified in different States for improvement / strengthening of the sub-transmission and distribution network in such a manner as to develop them as Centres of Excellence. Latter on circles and towns with concentrated loads were gradually added.". (NTPC 2001).

In Gujarat, this has meant the infusion of Rs 9,050 billion into 10 different distribution circles from 2000-2003, but only Rs 215 billion had been released by the Ministry of Power by June of 2003. The GEB claims that transmission and distribution (T&D) losses have decreased to only 15 percent in several of the upgraded distribution circles and that metered connections and reliability have increased (GEB 2003). Unfortunately, the improvement in distribution transformers has been marginal, decreasing in 2001-2 to 2002-3 by only 0.68 percent, from 20.58 percent to 19.7 percent (GEB 2004). Further, the Central Electricty Authority reports that Gujarat T&D losses increased from 2001-2003 by 1.5 percent to 28.5 percent (MoP 2004).

While the APDRP has given incentives to the SEBs to improve performance, and thus receive more central government funds to leverage and invest in the distributions sector, the funds cannot adequately make up for lack of investment during the past three decades of high demand growth. The distributions system remains fragile and the funds motivated by the programme do not meet the massive needs of the sector.

The other major actor in Gujarat reform has been the Asian Development Bank, which approved in 1996 a $250 million loan and $850,000 grant to aid GEB restructuring and build capacity in the Gujarat Infrastructure Development Board (GIDB). In 2000, the ADB approved an additional two part loan totalling $350 million to aid the GEB and GERC and build transmission capacity (ADB 2000). The overall intention was to break the GEB into well defined and ring-fenced corporate bodies, including two new generation companies, and Transco and one distribution company. This programme was deemed successful on paper, but multiple interviews in Gujarat confirmed that the reform has been mostly on paper and true ring-fencing will have to wait until the GERC takes action to enforce the firewalls between the new companies.

3. Power Investment in Gujarat, India

India is facing a confluence of forces in the power sector; high demand for electricity, ageing power infrastructure, a new regulatory climate and newly discovered, large supplies of natural gas. With annual GDP recently growing between seven and nine percent, and inter-fuel substitution away from traditional sources to electricity (Ghosh 2002), electricity demand growth has been rapid. Historically, power demand grows between 1.5 to 2.0 times faster than GDP during the period 1980-2000. Therefore, with annual GDP growth expectations of more than seven percent for the next several years, peak and total power demand is likely to increase by more than 10 percent per year (MoP 2007).

To meet this demand, a broad range of technologies and fuels are available. The long lifetimes of power sector capital investment means that decisions now will have long-term implications for the Indian economy and the development of a sustainable and reliable energy portfolio. This paper sets out a pragmatic strategy that could help overcome the structural and political problems hindering more power sector investment in India. The case of Gujarat is examined in detail because the high existing penetration of captive power in industry makes it an ideal candidate for "bottom up reform" to take hold most quickly.

The Indian ESI will need to grow to help sustain a path of seven percent GDP growth, and the government will be under pressure to deliver better results. However, past performance suggests that a government-only solution will not be adequate and increased private participation in the ESI is needed.

The India Planning Commission has responsibility for laying out the total capacity addition targets for the country in its five year plans. In the 9th Plan (1997-2002) the Commission set a target of 40,000MW, but achieved only 19,000MW. In the 10th Plan (2002-2007) an expanded target of 43,000 was set. Industry observers agree that the targets have historically been overly optimistic and will likely continue to be missed by approximately 50 percent in each plan. The most obvious causes are limited resources for investment by the government and the highly indebted position of the SEBs, and have been well described in the literature (Rao, Kalirajan et al. 1998; Dubash 2001; McKinsey 2001; GoI 2002). Both plan periods include a heavy reliance on private sector investment to achieve "adequate" capacity. However, they rely on the state sector as the primary buyer of generation output. Unfortunately, this centrally planned model depends on the already exposed financial position of the SEB's. IPP investment during the 9th and 10th plans has been sparse, principally because the state-owned utilities have not been reliable buyers for merchant plant power.

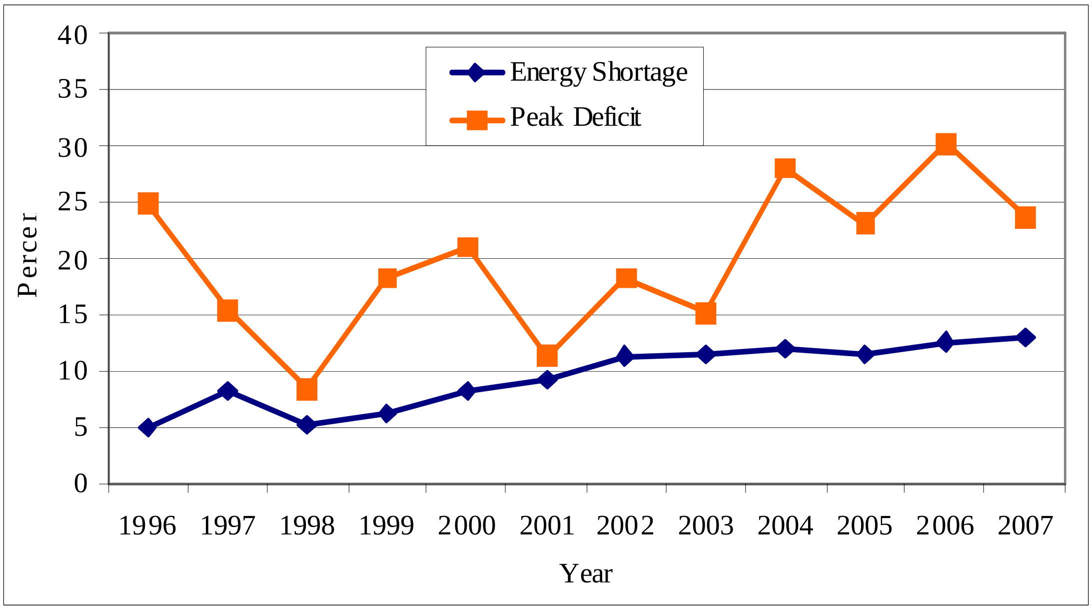
3.1 Power Shortages and Grid Instability

Power shortages in India are widespread and have intensified in duration and scope in the past decade (PC 2002). Several studies have sought to quantify the damage from poor power quality and availability to industry and the economy as a whole. Their finding suggests that GDP growth has been retarded as a result (CII 2002; Nexant 2003). The Indian Power Minister reiterates this point in 2004:

> "The industry in India has among the highest tariffs in the world and is not yet assured of the quality of supply. In this era of globalisation, it is essential that electricity of good quality is provided at reasonable rates for economic activity so that competitiveness increases. Being internationally competitive is now essential for achieving the vision of 8-10 percent GDP growth per annum, leading to employment generation and poverty alleviation." (Sayeed 2004)

For example, in Gujarat the power shortage problem is acute and has not shown sign of improvement despite GEB efforts. Figure 2 shows the recent trends for both peak and total energy shortages as estimated by the Ministry of Power. One solution is to use demand side management (DSM), but it is likely to deliver no better than 10-15 percent of the gap in power (Abraham 2004).

Figure 2: Gujarat Energy Shortages and Peak Deficit 1996-2007



Source: (MoP 2005; CEA 2007)

In short, the availability of reliable and stable power supply for industry and small consumers is an ever widening gap. Capacity addition will have to outpace demand growth, which is linked to GDP expansion, to reduce the shortfall (Mitra 2003). This relationship dictates that power output will have to grow by more than 20 percent to make up any ground on the shortages. One note of caution with these numbers is that demand at subsidised prices is likely overstated, and some inflation of the problem helps certain constituencies as well as some government agencies that base funding allocations on the shortage figures.

SEB across India are bankrupt, a position well documented in the literature (ICRAb 2003; Morris 2003; ICRA 2006) and caused by a number of factors, most significantly the use of the SEBs by the state governments to finance expenditures and to subsidise important political constituencies, such as farmers and urban elites. In Gujarat, this is certainly the case with total shortfalls before the state subsidy totalling Rs 32 trillion in 2004 (GEB 2003). In 2006, the erstwhile GEB still relied on state subsidies for more than 15 percent of total revenues and the company has a high negative net worth and high debt levels. (ICRA 2006). The GEB is not in a strong position to invest in new infrastructure under the current operational climate and the planned continued use of the Board to provide cheap power is unlikely to help remedy the situation.

3.2 Distribution Reforms in Gujarat Using Private Sector Franchising

The GEB has begun to take action to address transmission problems by applying APDRP funds to reduce losses and increase metering (GEB 2003). In addition, the GEB has put out tenders for private sector participation in selected distribution circles (January 2004), but many unresolved issues about how capital expenditures, manpower and revenue sharing will be handled have yet to be negotiated and implementation will be slow. In the words of the GEB Member for Finance: "[franchisee distribution companies] are being explored [as an idea] so that we know who is in our backyard" (Joshi 2004). Private sector involvement in distribution is anticipated in Gujarat and the SEB is trying to control the process through a programme of tenders and thus show the GERC that it is open to private investment. However, even if the franchisee model comes to fruition, all power purchases will be from the GEB and no direct bi-lateral supply contracts between generation and consumers will be allowed (Joshi 2004). This ensures captive customers for the GEB and reduces competition. A more proactive approach is needed to encourage real competition and the enabling legislation has now been passed by the national government in the form of the 2003 Electricity Act (Padmanaban 2003; Sankar 2004), which is discussed in the next section.

3.3 Electricity Act 2003 and Gujarat Legislation

The legislative process that produced the 2003 Electricity Act (EAct) spanned more than five years and involved hundreds of consultations, drafts and delays (Dubash 2001). It forms the basis for the most fundamental rethinking of the power sector in India since the 1948 Electricity Law after independence created the State electricity Boards (Rao 2003).

The EAct requires corporatisation of all SEBs and moves from a single-buyer model to a multi-buyer system by enabling bilateral trades, inter-state power trading and trading licensing. In generation, the act effectively delicenses the sector and grants unfettered approval for captive power plants, which is the focus of the second half of this paper. The Act has already been amended with the passage of changes in December of 2003 that limit investigative and police power for power theft and most importantly, the addition of time limits -- three to five years -- for SERCs to introduce open access for transmission and distribution.

The EAct has been described by D.V. Kapur, head of Reliance Power, as the first step in 10 toward reforming a broken system, but at least it is a step forward. The reality of this statement was confirmed shortly after it was passed with many states requesting more time to implement its requirements and backtracking on charging for power for farmers. Andhra Pradesh, Tamil Nadu and Maharashtra state governments have all announced their decisions to give free power to agricultural consumers (Godbole 2004).

In Gujarat the process of power sector reform was complicated by a similar piece of state assembly legislation that passed in June of 2003. The state requested an extension for the implementation of the Act and was granted an extra six months, to December 2003, but this was extended for another 12 months, conveniently until after the general election. The new Congress-lead United Progressive Alliance (UPA) government in the centre came under direct pressure from its partners on the left (e.g. Communist parties from West Bengal) to review the original act and many attempts were made to water it down and delay implementation further. To its credit, Prime Minister Singh, an original architect of the first reforms in 1991, has stayed true to the goals of the act, and while agreeing to a review, has not wavered in pushing forward with implementation. The power secretary commented in November 2004 that no more time would be allowed for SEB corporatisation (TNN 2004). However, several two-month extensions were granted and the final line has yet to be drawn in the power struggle between the states and the central government. This tension is especially acute in the case of Gujarat, where the BJP is firmly in control of the state assembly and CM Modi controls the energy portfolio. Without a commitment from the SERCs to deal with the complicated and politically volatile details of transparent and fair markets, the Act will not be effective at encourageing new private investment. The critical areas for consideration are covered in details in Section 4.

In the summer of 2005, the UPA government has come under intense pressure, both from its partners on the left and the opposition BJP on the right. PM Singh has signalled his intent to continue pushing to end free power for farmers, but the reality has been a series of announcements by state governments to continue the practice. The government has had to extend the deadline for SEB unbundling again, this time to December 2005 and fight a rear guard action against its coalition partners, principally the communists (Economist 2005). The EAct amendments being pushed by the left have left many of the key provisions of the act in question. Amendments include the removal of the provision for the elimination of cross subsidies, an increased role for the centre in rural electrification, removal of regulators authority to set tariffs and a further extension of the SEB reorganisation deadline (TNN 2005). The Communists are moving to push rural power programmes, protect SEB workers and keep control of power prices. They have been adept at slowing or changing the direction of the reform plan and may undermine the intent of the 2003 legislation with the raft of changes proposed (Bhattacharjee and Goswani 2005).

4. Captive Power in India

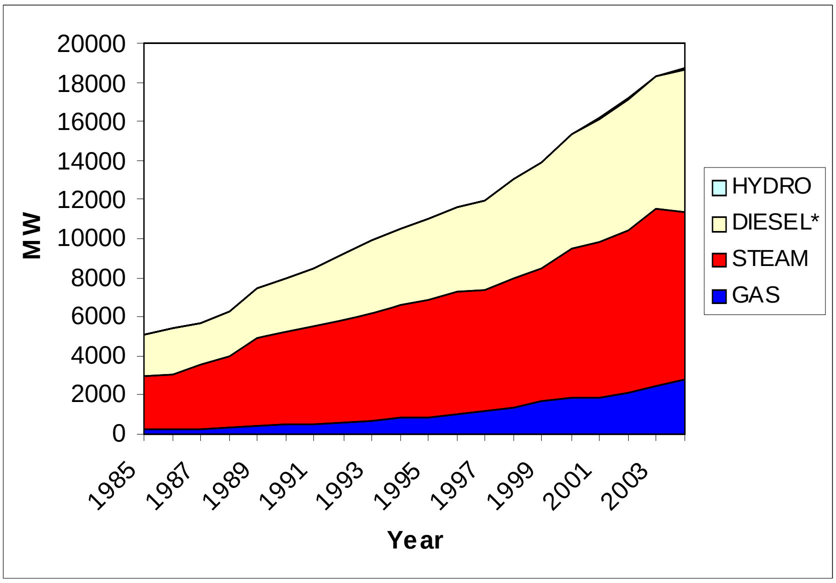
Captive power plants have been an integral part of industrial production across the developed and developing world. In many areas where reliable power is expensive of difficult to access, industry has taken matters in to their own hands and developed power systems to meet their individual needs. This approach is manifest over a range of projects, from a simple diesel gensets up to large scale coal and natural gas-fired generation units which also supply steam or heat for production processes. However, given this long history in India and elsewhere, the current state of economic or policy analysis for independent and captive generators and their role in the power sector in developing countries is one of general neglect.

The wide-ranging study by the IEA on India, gives only two short paragraphs to describe captive power (IEA 2002) and several other recent books (Nair 2000; Rao 2004; Yi-Chong 2004) do not focus any analysis on the distributed, captive and independent generators in the Indian system, which make up approximately 20 percent of installed capacity and more than 30 percent in most industrial states. To bridge this gap in understanding, Section 3 first describes the scope of captive power and its role in Indian industry, followed by an examination of the political and economic reasons for using a bottom-up approach for ESI sector reform in Gujarat.

4.1 Role of Captive Power in India

Captive power has played an increasingly significant role in Indian industry, both as a back-up source of generation and as the primary power supply for many industrial facilities. Figure 3 shows how each of the different types of CPP have grown since 1985. CPPs have grown at a steady and increasing rate since the pre-reform period of the mid 1980s. From 1995 to 2004, captive generation capacity has increased by 68 percent. This upswing indicates the speed of industrial conversion to own generation when faced with high industrial tariffs, poor service and non-availability of grid power.

Figure 3: Indian CPP Growth by Fuel Type



Source: (CEA 2005)

In Gujarat, the figures are even more pronounced, with a 400 percent expansion of CPP capacity from 1991-2002 (Shukla, Biswas et al. 2004). Gujarat is one of the most highly industrialised of the Indian states and continues to be the industrial base for chemical, fertiliser, petroleum, textiles and non-ferrous metal production. As a consequence of poor power supply and high tariffs from the SEBs as well as an encouraging captive power policy by the state government (Shukla, Biswas et al. 2004), Gujarat has seen a rapid increase in captive power plant capacity, rising from less than 1 GW in 1996 to more than 2.7 GW in 2005.

CPPs now make up nearly 30 percent of total installed capacity in India. This level of private power generation is an industry response to high tariffs and poor power supplies. A recent power survey by industry association and the IIM-Ahmedabad has confirmed this finding (Shukla, Biswas et al. 2004) and the PHD Chamber of Commerce and Industry (PHDCCI) also cites frequent power cuts as the cause of dependence on own generation. The survey of 90 companies found that unreliable power supply forced them to turn to captive power generation and 55 percent said they met 10 to 40 percent of their power needs through captive power plants. The survey also found that high levels of small CPP, especially diesel gensets, push up production costs and undermines the competitiveness of industry. (PTI 2005). In Table 1, all CPPs over 1 MW in size that report to the Central Electricity Authority are described.

Table 1: Indian CPP Characteristics, 2004

Size (MW)	No. of Generating Industries	Aggregate (MW)	% age of Total Capacity	Aggregate (GWh)	% age of Total Generation	Average Size	Average PLF
1 to 10	2001	5455.32	29.11	7987.34	11.72	2.73	16.7%
10 to 20	156	2156.02	11.51	5707.81	8.37	13.82	30.2%
20 to 30	78	1864.16	9.95	7443.9	10.92	23.90	45.6%
30 to 40	40	1321	7.05	5452.24	8.00	33.03	47.1%
40 to 50	18	776.59	4.14	3428.3	5.03	43.14	50.4%
50 to 100	37	2423.68	12.93	12574.51	18.44	65.50	59.2%
100 plus	19	4743.54	25.31	25579.02	37.52	249.66	61.6%
Total	2349	18740.31	100	68173.12	100	7.98	41.5%

Source: (CEA 2005)

The Indian CPP capacity is characterised by a large number of small plants and a few large installations. The latter category (50MW and up) produce more than 55 percent of all CPP electricity, have the highest PLFs and average 128 MW in size. The aggregate PLF of all CPP over 1 MW is only 41.5 percent and this figure is even lower when smaller plants are considered, although the CEA does not keep records for CPP of less than 1MW in size. The low PLFs indicate a possible opportunity to bring more power into the grid for sale if the regulatory conditions are conducive, particularly for the larger plants with lower marginal costs.

To understand this story more completely, it is helpful to look at how industrial states, like those selected in Table 2, have used CPP. Gujarat, Andhra Pradesh (AP), Tamil Nadu (TN), Orissa and Maharashtra (Mah) are home to 90 percent of all exported CPP power and approximately 50 percent of all industrial power used in India.

Table 2: Captive Power Use by Industry in Selected States and India, 2004

CPP by Industry (GWh)	Gujarat	AP	TN	Orissa	Mah	INDIA
Auxillary Consumption	591.7	571.0	394.8	1015.8	157.7	5209.0
Net Generation	11148.5	6487.4	5037.9	8181.0	4616.1	62964.1
Export to Utilities	608.9	1961.3	1096.7	1169.9	130.4	5566.9
Self Use	10539.6	4526.1	3941.3	7011.1	4485.7	57396.9
Imports from Utiliites	3840.4	4929.2	3599.4	870.9	5099.6	39279.6
Total Energy Consumed	14379.9	9455.3	7540.6	7882.0	9585.3	96676.6
% of Total from CPP	**73.3%**	47.9%	52.3%	89.0%	46.8%	59.4%
% Exported	5.5%	30.2%	21.8%	14.3%	2.8%	8.8%
% Imported	26.7%	52.1%	47.7%	11.0%	53.2%	40.6%
% Imports/CPP	36.4%	108.9%	91.3%	12.4%	113.7%	68.4%

Source: (CEA 2005)

The table helps to put into context Gujarat's relative position against other industrial states that use CPP. There are a number of local factors that influence these figures, but several important observations can be gleaned from the numbers. First, Gujarat exceeds the national average for the percentage of total power used in industry with CPP that comes from captive plants but those same plants export very little power to the grid, 5.5 percent. Second, Gujarat industry with CPP imports 26 percent of its power needs, which is about half of the percentage of imports in AP, TN and Maharashtra, where industry with CPP gets more power from their SEB or NTPC. Third, Gujarat CPP is more than 17 percent of all CPP in India. Third, Gujarat CPP is more than 17 percent of all CPP in India, but that state uses only 13 percent of Indian industrial power, as shown in Table 3, where CPP use is put in context will total industrial power use in selected states.

Table 3: CPP Exports and Total Industrial Energy for Selected States, 2004

State	CPP Exports (GWh)	% of Exports	CPP Industrial (GWh)	Utility Industrial (GWh)	Total Industrial (GWh)	CPP % of Total
Gujarat	609	10.9%	14380	15293	30282	49.5%
Andhra Pradesh	1961	35.2%	9455	9064	20481	55.7%
Tamil Nadu	1097	19.7%	7541	15262	23899	36.1%
Orissa	1170	21.0%	7882	3078	12130	74.6%
Maharashtra	130	2.3%	9585	19962	29678	32.7%
Subtotal	4967	89.2%	48843	62659	116470	46.2%
All India	5567	100.0%	96677	124572	226816	45.1%

Source: (CEA 2005)

Gujarat produces 50 percent of its industrial load from CPP, while CPPs exports are only 609 GWh, or 2 percent of total industrial demand. The five states together, and Indian industry as a whole, are heavily reliant on CPP for power.

Gujarat is one of the most highly industrialised of the Indian states and continues to be the industrial base for chemical, fertiliser, petroleum, textiles and non-ferrous metal production. As a consequence of poor power supply and high tariffs from the SEBs as well as an encouraging captive power policy by the state government (Shukla, Biswas et al. 2004), Gujarat has seen a rapid increase in captive power plant capacity, rising from 1 GW (13.1 percent of the total) in 1996 to 2.19 GW (20.7 percent). Table 4 shows the breakdown of CPP capacity by industry, note that this data represents the official figures from the government and do not include small CPPs, which may push the total to 2.7 GW as estimated by GERC.

Table 4: Gujarat CPP (sized 1MW or greater) Capacity and Energy Production 2003-4

Gujarat	Cement	Chemicals	Fertiliser	Petroleum	Textile	Total
CPP Capacity (kW)	126620	965693	200320	748080	219666	2556759
CPP Average PLF	57.92%	57.62%	45.67%	52.86%	51.33%	52.42%
CPP Energy (GWh)	642.44	4874.12	801.37	3463.85	987.69	11740.16
Use by Industry w/ CPPs (GWh)	711.59	4778.16	993.76	3281.99	1231.26	14379.94
Industrial power from CPP	90.28%	102.01%	80.64%	105.54%	80.22%	81.64%

Source: (CEA 2005)

The use of captive power in Gujarat can be analysed from several vantage points. First, is the concentration of its use in selected industries in Gujarat, as given by five columns in Table 3.4. The state has a large concentration of chemical plants, which account for 39 percent of all energy used in that sector across India for plants with CPP. The same is true in petroleum, where the Gujarat installations account for 48 percent of power used in India in this sector for operations with CPP. The five selected groups are responsible for 88 percent of the CPP in Gujarat. Economic geography theory would predict the agglomeration of industry types by location, and this holds up in practice in Gujarat for these five sectors (Hanson 2000).

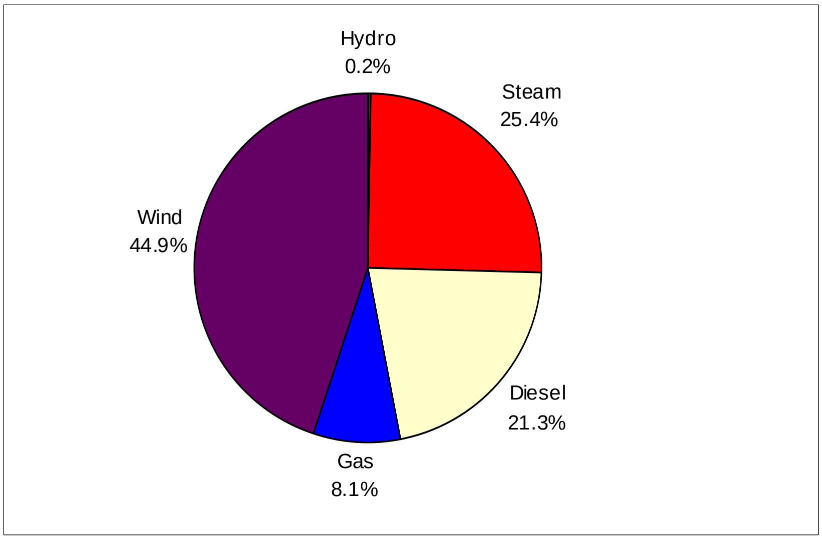
The next factor to consider is the plant load factor (PLF) of the CPPs. The relatively low PLF for each industry and aggregate PLF for all CPP in Gujarat indicate a huge dead weight loss from the under-utilised capacity (Morris 2003). The state is short of power, but 7500 GWh of power that could have been produced at 85 percent PLF is unrealised. While this calculation is simplistic in that it leaves out the cost of fuel and transmission capacity considerations, it nonetheless makes the case that existing and new CPP plants could be easily utilised to boost power output in Gujarat and across India providing adequate economic and regulatory incentives were in place.

Third, Table 4 shows how the different industries use CPP, in each case the use is more than 80 percent of energy needs and for chemicals and petroleum, they are actively involved in the export of power to other sectors (i.e. above 100 percent). For the state as a whole, captive power is 81 percent of power used by industries with captive plants and is approximately 50 percent of all power used in the state by all industrial units.

4.2 CPP Capacity by Fuel

The choice of fuel for a captive plant is highly dependent on the size of the plant, its intended use and fuel availability/price. For back-up generation, smaller, liquid-based internal combustion engines are normally used. For large scale operations with access to coal allocations or gas pipelines, these have been the fuel of choice. Figure 4 displays the breakdown of the number of medium and large scale plants by fuel type.

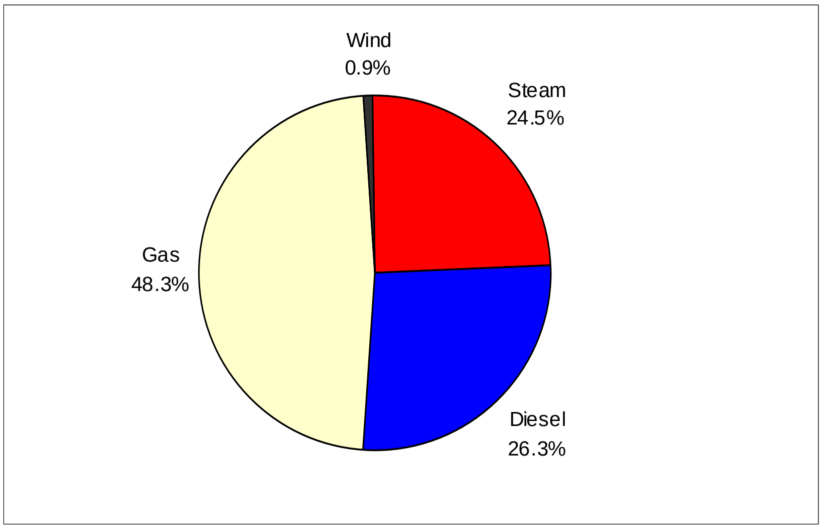
Figure 4: Indian CPP plants 1 MW and up by fuel type, 2003-4



Source: (CEA 2005)

Figure 4 presents a misleading picture of CPPs by treating each generation site equally. The hundreds of individual wind turbines are given undue importance using this accounting method. More informative is the breakdown by capacity, which is shown in Figure 5.

Figure 5: Gujarat CPP Capacity for Plants 1MW and up by Fuel, 2003-4



Source: (CEA 2005)

Wind plays only a small role in CPP power production, as would be expected with a small, low PLF fleet of turbines currently in use. Most of the wind projects were done for the tax benefit to the parent company and had little to do with providing power to the owners or selling to the grid. The remaining three categories give a good indication of what the usage profile for Gujarat CPP looks like, with nearly 75 percent either gas or thermal, and thus mostly used for direct supply to the factory or parallel operation with the grid. The 26 percent that uses diesel is mostly the back-up generation or emergency supply that typically has a low utilisation rate and high marginal costs.

The overall picture of Gujarat CPP is one of fast growth in a highly industrialised state with poor service form the SEB and high tariffs. When large industry can gain access to fuel supplies it has overwhelmingly voted with its feet and invested in self generation to some extent. Medium and small firms with either a lack of capital or no access to coal and gas allocations form the state have had to make due with intermittent service from the GEB and a fleet of back-up diesel gensets. In Section 5 the paper looks more closely at how why more CPP and merchant plant developed using a bottom-up approach is the best available solution for Gujarat as it tackles ESI reform. Change to the status quo is needed to allow more industries access to CPPs and reduce the inefficiency of the state led system.

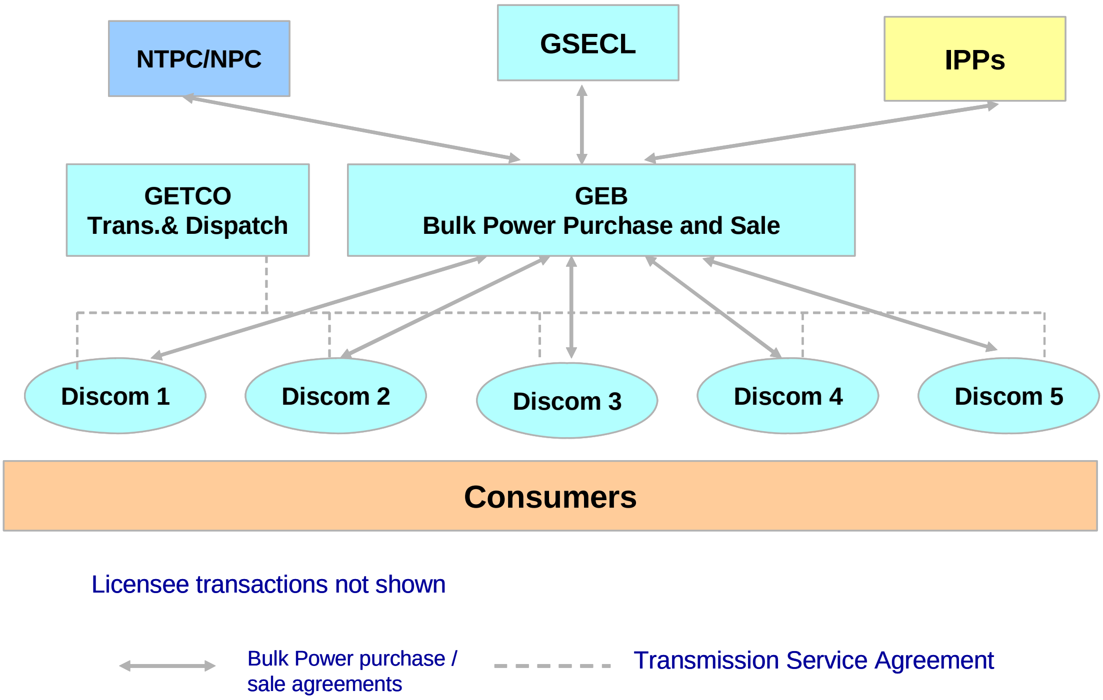
5. The Advantages of a 'Bottom-up' ESI Reform Approach

The literature on electricity reform programmes around the world tells a consistent story about the political constraints that have either stopped or altered power sector changes (Dubash 2002). Successful reform programmes need support from a wide range of political constituencies to remain viable and one of the inherent advantages of using a bottom-up approach to power sector change in India is that it is likely to leverage the support of several important groups, while avoiding a direct challenge to incumbents, such as the state electricity boards or the agriculture lobby.

Bottom-up approach avoids directly confronting state electricity boards

Power reform efforts in India which have directly dismantled the SEB, for example in Orissa, have had to contend with a strong political backlash from utility unions and from the groups that benefit the most from subsidised power, agriculture and domestic consumers. The most powerful player in the sector in Gujarat is the incumbent, the erstwhile Gujarat Electricity Board (GEB) and its subsidiaries, now know as the Gujarat Urja Vikas Nigam Limited (GUVNL). The GEB has advocated for a top-down restructuring of the industry, but one which assures it of continued control. Figure 6 displays the proposed GEB plan that was accepted by the Gujarat Electricity Regulatory Commission (GERC) in 2005.

Figure 6: GEB proposed industry structure in Gujarat, (GEB 2003)



Essentially, the GUVNL proposed to maintain control over the generation, transmission and supply sides of the sector, while privatising or franchising the distribution sector. This approach would retain the single buyer aspects of the current system, a approach that copies the Orissa model, but without the selling off of state generation assets. An alternative approach would be to promote the widespread use of captive power plants by creating regulatory and economic incentives, instead of the current restructuring of the incumbent that further entrenches its market power. With proper implementation, more CPPs would result and GUVNL would be challenged from the outside instead of retaining protection for the status quo.

Monopoly players, such as the GUVNL will try to resist changes and have several advantages over the regulators in doing so. First is the principal-agent problem where even an aggressive effort by the state regulator, GERC, can be delayed or watered down by agents within the Board. For example, the implementation of the open access provisions of the Electricity Act can be stopped by the SEB using a number of technical hurdles (Abraham 2004). These include misreporting transmission capacity, creating congestion, allowing preferential access to GUVNL generation plant, manipulating transfer pricing, etc. In this situation, the principal regulatory body (GERC) will suffer from an information asymmetry in that transmission capacity and transfer pricing information is not transparent and the commission does not have the time, funds or expertise to solve the imbalance.

5.1 Avoids confronting agriculture subsidy problem

A phased entry of new CPP as a competitive threat to the GUVNL will also avoid the need to directly confront agriculture subsidies and will thus reduce the opposition from the agriculture lobbies. Certainly the lower revenues will have an effect on the resources available to pay for cheap power to farmers from within the Board's revenue, but this system is under direct challenge anyway. The Electricity Act's express intent is to make all subsides the responsibility of the state government, instead of the current pattern where the state governments use the SEBs to pay for the subsidy and reduce the need to borrow to pay for the entitlement. Under the new Act, significant new CPP entry would likely force the state to better control and target subsidies instead of continuing the slow fiscal drain that has gone unabated for more than 20 years. Sebastian Morris, of the IIM-Ahmedabad, has written extensively about how to better target the agriculture subsides, and suggests that direct, coupon-based system is the only way to reduce both the leakage to illegal benefactors, such as industrial users, and to control the growth of the subsidy (Morris 2000; Morris 2002; Morris 2003).

More CPPs will also free up more low-cost GEB capacity to provide power to vulnerable sectors of the economy. This argument is explained more broadly by Sankar, where he proposes partitioning the electricity system and using the lowest marginal cost plants owned by the SEBs to supply cheap power to targeted sectors and requiring industrial users to take care of themselves. By using the case of Andhra Pradesh, Sankar shows how the approach could eliminate the need for ongoing government subsidies (Sankar 2002). Morris takes a different path, arguing that higher PLFs in GEB plants (as well as CPPs) and demand shifting of subsidised sectors to off-peak hours would alleviate the capacity shortages (Morris 2003). In essence this would mean that irrigation pumping would be moved to night hours and the resulting demand could be met with better utilisation of existing generation assets.

The idea of pushing low paying sectors to off-peak times and using CPP is exactly the market response you would expect in a fully competitive environment. It is expected that more merchant and captive power capacity would provide power for industrial sector and thus allow the state to continue the subsidies to agriculture. Ultimately, this may be the political compromise that is needed to make the Electricity Act successful and dull opposition to reform plans.

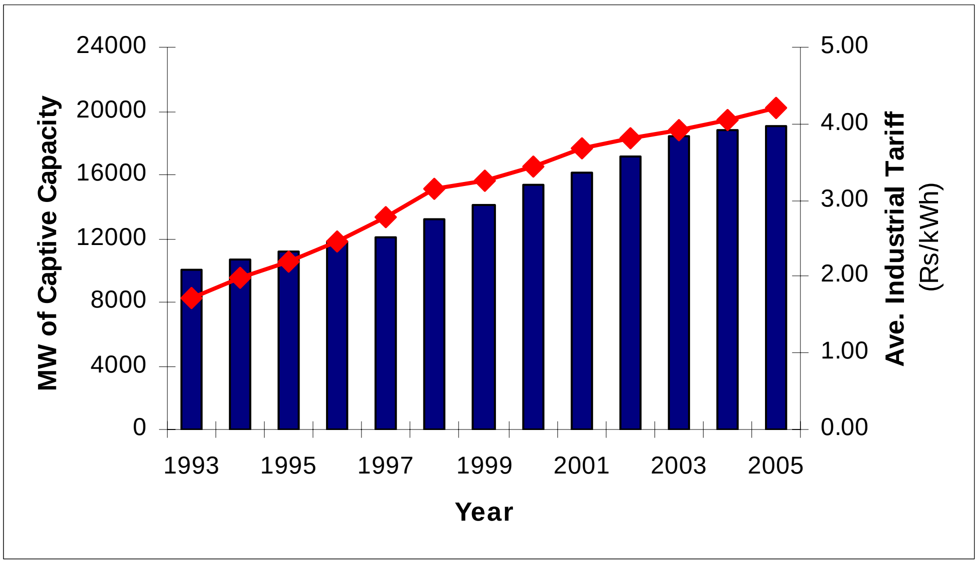
5.2 Benefits for Industry

The use of more CPPs in the Gujarat power sector has the potential to be beneficial for industries that have historically been starved for power and for quality service. When power is provided by state electricity boards, the tariff regime effectively taxes industrial consumers to enable cross-subsidies for the rest of the customer groups. This makes India an outlier among other industrial and developing countries by having a high industrial tariff to domestic tariff ratio (Rao 2003).

The high industrial tariffs have lead many large manufacturing plants to choose captive generation and abscond from the grid system, which acts to undercut the revenue of the SEBs even further. Morris highlights the problem by calling current tariff levels "unsustainable and dysfunctional" and they make even very small CPPs (under 5MW) more costs effective for industry. The high tariffs create a competitive disadvantage for Gujarat businesses and only high interest rates and restrictive regulation regime for CPP keep consumers within the GEB, (now GUVNL) system (Morris 2003).

Figure 7 shows how the capacity of the large captive plants has increased with the rise in average industrial tariffs. The figures underestimate the total captive power, as only units larger than one MW are included, which ignores the numerous diesel gensets used by small industry, which total as much as 50 percent of documented CPP (IEA 2002).

Figure 7: All-India Captive Power Capacity and Average Industrial Tariffs



Source: (PC 2002; CEA 2003; CEA 2006)

One point that is more difficult to quantify, although several studies have attempted to do so, as summarised in (CII 2002; Nexant 2003), is the value of unserved load and the costs of having an unreliable power supply. Undoubtedly, poor power quality has been a driver for industries to choose captive supplies. The high power tariffs for industry also impinge on international competitiveness of Indian manufacturing firms.

Looking forward, the most likely candidates for using captive power are the same customers that are most valued by the GEB (Abraham 2004). This trend has already accelerated with the cash-strapped SEBs now losing the monopoly they enjoyed as the single purchasers of electricity from generators. The Act has allowed power trading companies to establish themselves as the "middlemen" between SEBs and CPPs, and have signed power purchase agreements with new producers. However, some government officials are wary that inadequate transmission infrastructure is restricting trading activities (Joseph and Nair 2004).

5.3 Provides reform pressure on incumbents

The third advantage of using a bottom-up change to the sector is that it will provide real competitive pressure on the incumbent at every level in the ESI. The entry of new captive capacity with excess output available to sell to power traders and on bi-lateral contracts would force the GEB to respond with better customer service and reliability to maintain market share. As the Minister for Power stated in 2004:

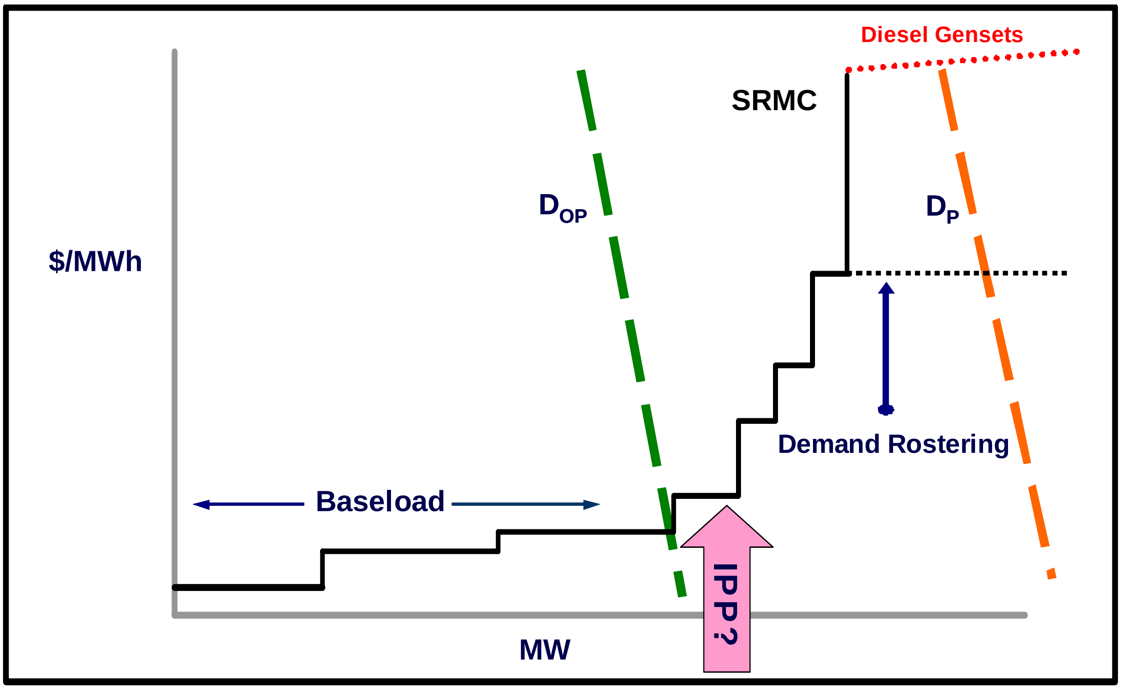
> "The liberal provision regarding captive generation while giving choice to the consumers to generate electricity for their own use, also seeks to create competitive pressures on the existing utilities to improve their performance. Availability of power to industries, especially to small scale industries, at competitive rates will catalyze employment generation in a large way." (Sayeed 2004)

The key for captive power entry is a clear schedule of costs and regulatory obligations. One of the principal concerns is the use of surcharges to continue the regime of cross-subsidisation. Political signals from around India indicate that some form of cross-subsidies will continue. The Electricity Act amendments in December 2003 compel the SERCs to set a timeline for their removal, but they have yet to be fully enforced. For example, in 2005, the final regulations were issued by the Gujarat Electricity Regulatory Commission (GERC), but the implementation schedule remained vague. Phase 1, for generators above 5MW are to be granted open access "after Intra-State ABT is put in place or 1 January, 2006 whichever is later". In Phase 2, for generators 1 MW or larger, open access begins "2 years after introduction of 1 above" (GERC 2005). In accordance with this ruling, Gujarat granted open access to units 5MW and above on January 1, 2006 and for unit 1 MW and above on January 1 2008. In many states, no ABT finalisation has occurred, thus all open access deadlines have slipped further. This pattern of delay has served to undercut the financial viability of many CPP projects.

5.4 Economic Arguments for Captive and Distributed Power

In the current situation, the demand and supply picture can be described as one of severe shortages and thus significant power cuts for many categories of users. Random power cuts and planned "demand rostering" reduce industrial productivity and lead to power quality problems. To illustrate the problem, Figure 8 captures the main market dynamics.

Figure 8: Supply and Demand Schematic in Gujarat, 2007

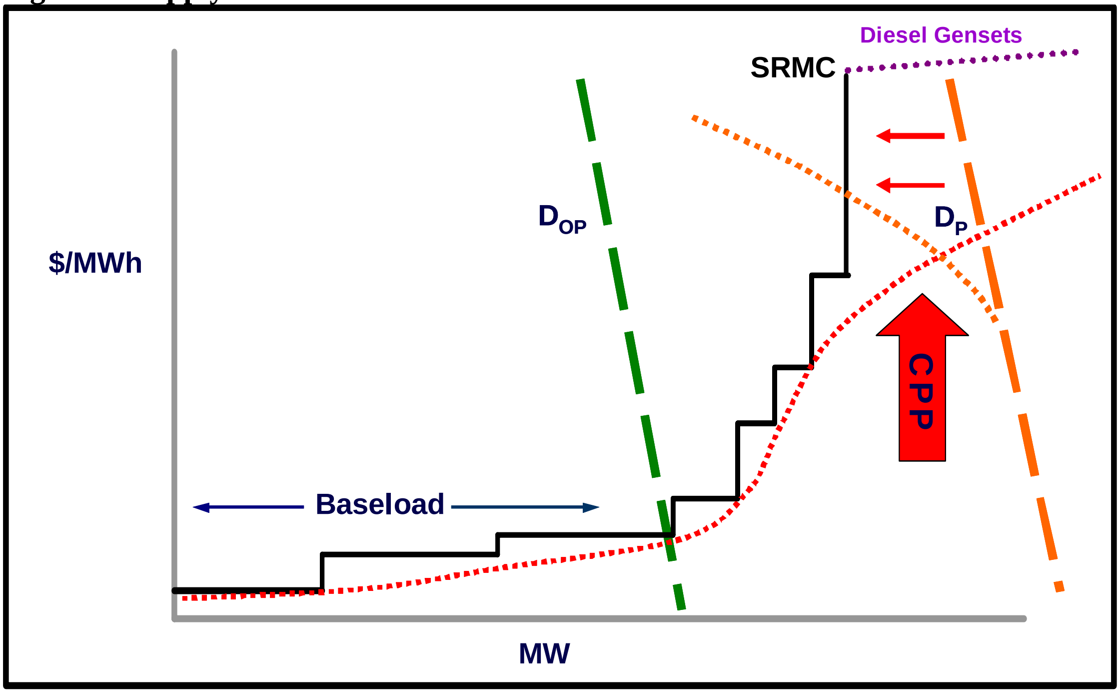


The supply curve, in this case displayed as $/MWh of short-run marginal cost (SRMC), stats on the right with the low cost baseload units, principally coal-fired, large capacity units owned and operated by the NTPC and GUVNL. During off-peak demand periods (D_{op}) the baseload capacity is adequate, but as demand increases to the evening peak (D_p), the higher cost, mid-merit order units (including IPP units) are not able to fully meet demand and "rostering" (outages) occur. The market has responded to this situation by buying its own capacity, normally in the form of diesel gensets, which is represented by the top (dotted) portion of the supply curve. Diesel gensets are more expensive than grid connected supply but are the only option for many consumers during peak periods.

5.5 Encourages capacity addition at top of supply curve

The addition of more CPP and distributed generation can be beneficial to the system for a number of economic reasons. Figure 9 is used to illustrate the changes that more CPP would bring to the power market in Gujarat.

Figure 9: Supply and demand schematic with increased CPP



More CPP can significantly improve the supply situation in the Gujarat power market through two main effects. One, more "grid-tradable" CPP capacity would add MWh to the grid during the times when it is needed the most, peak demand hours. Industry is in the best position to sell high priced power to the grid and adjust self consumption by shifting or reducing production when the sale price of power is high. Gas-fired CPP plants have higher marginal costs than the baseload units, but are much less expensive to run than the diesel gensets, as shown in the figure. Two, additional CPP extends the supply curve to the right by adding capacity and thus reducing demand rostering/power cuts.

The other important effect to consider is the reduction in peak demand caused by more industrial units, distribution companies and local administrative units using CPP. D_p is bent to the left by the combination of more self-generation and the inherent demand side management practised by the price responsive generators at high prices. In effect, more CPP would cause the demand and supply curves to intersect at a market clearing price that is a function of thousands of individual CPP owners adjusting their output and power consumption to best take advantage of arbitrage opportunities. An important caveat to this scenario is that it makes the assumption that markets exists for the free trading of power and that buyers can access suppliers without the real life constraints of transmission congestion. Over time it is the goal of regulators to open this up to full access, but as the regulation matures, intermediate steps are available, such as bi-lateral trades and the activities of the PTC which will provide both long-term and short-term power off take agreements for merchant plant owners. The creation of a competitive electricity market relies on many buyers and sellers of electricity who are responsive to price (Hunt 2002), and as CPP is added to the wholesale and bi-lateral electricity market, price responsiveness and plant utilisation will both increase.

5.6 Reduces SEB market power

Captive power has already cut into the GUVNL's industrial supply market share, CPP is now estimated at 22 percent of total installed capacity in Gujarat (Shukla, Biswas et al. 2004), but may be one-third higher (approximately 4,000 MW) if small units are considered (Shah 2004). This has the overall effect of limiting the GUVNL's market power, but before the passage of the 2003 EAct, the monopoly status of the GUVNL was maintained by the lack of wholesale trading or bulk power and restrictive rules on CPP units to sell excess capacity.

Only large firms with steady access to fuel supplies and long term sales contracts with the GUVNL have been able to achieve technical-economic clearance (TEC) from the CEA, as shown in Table 5.

Table 5 Gujarat Power Plants with Technical Economic Clearance (MoP 2004)

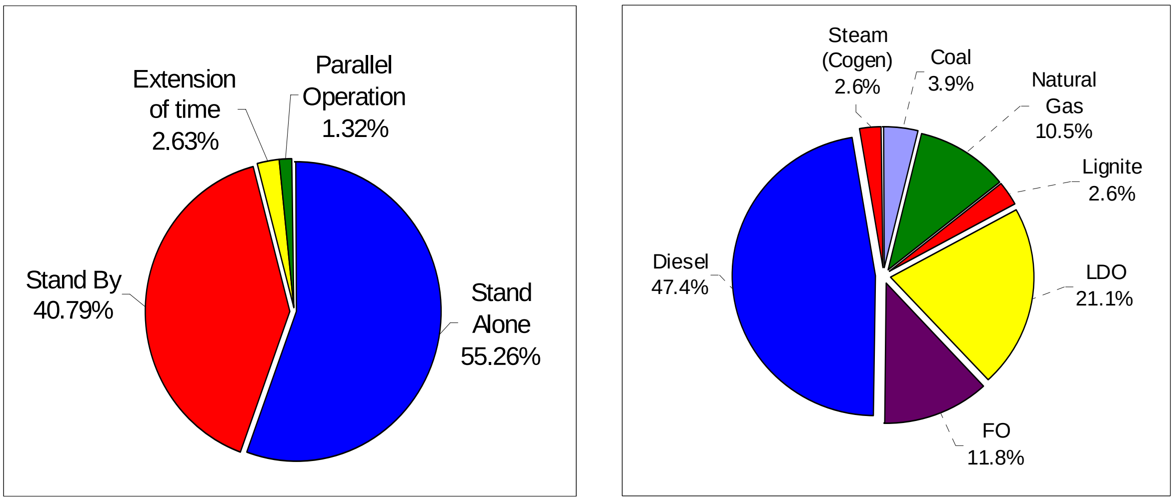
Power Plant	Capacity (MW)	Investment (Rs. Crore)
Paguthan CCGT (M/s Gujarat Torrent)	654.7	2298.14
Hazira CCGT (M/s. Essar Power)	515.0	1666.56
Baroda CCGT (M/s. GIPCL)	167.0	368.22
Surat Lignite TPP (M/s GIPCL)	250.0	1167.18
Jamnagar TPP (M/s Reliance Power)	500.0	2550.74

The first plant is owned by Torrent Industries, purchased from a Powergen subsidiary after its exit in 2000 from the Asian market. Second on the list Essar, which sells all of its capacity to the GEB under a lucrative contract - 770 million units at Rs 5.84/kWh in 2002. (Mathew 2002).

The next major player is Gujarat Industries Power Company, which is owned by a group of state owned companies: GUVNL, Gujarat State Fertilisers & Chemicals (GSFC), Gujarat Alkalies and Chemicals (GACL) and Petrofils Co-operatives. GIPCL is essentially a special purpose vehicle to supply industrial units around Baroda and may be an example of how the GUVNL can respond to CPP competition. GIPCL has higher PLFs, availability factors and better efficiency than other GUVNL units (GIPCL 2004). Last on the TEC list is Reliance Power, a wholly owned subsidiary of Reliance Industries. This plant mainly supplies the Reliance owned refinery at Jamnagar and currently has little spare capacity to sell to the grid.

With the implementation of the EA 2003, more CPP in the industrial sector can compete with the GUVNL for market share, especially as the PTC (and any new distribution licensees) contract for power supply directly with CPP owners (PTC 2004; Thakur 2004). More than 350 new CPP units applied for safety approval from the GERC from June to December 2003 (Shah 2004), seemingly in anticipation of this trend. Figure 10 shows the breakdown of a sample of the applicants by usage and fuels.

Figure 10: Sample of Gujarat Captive Power Applicants in 2003 by Usage and Fuel Supply



Source: (GERC 2004)

However, it is doubtful whether many of the proposed CPP in the 2003 batch of applicants will intend to sell much power for outside consumption. Most are being set up for stand-alone operation or back-up power supply. Without a clear regulatory environment to sell excess production, traded sales will be small in volume; however, the "stand alone" and "stand by" operators would be well positioned for sales to distribution companies and the PTC as access is granted by GERC.

From 2004 to 2007, a large number of new CPP projects were announced in Gujarat. Essar Power plans to build a 1000MW coal-based captive in Jharkhand to supply its three million tonne sponge iron facility (Energyline 2005). In Gujarat, Torrent Power Generation has signed an agreement with Alstom and the Asian Development Bank (each with a 10 percent stake) for a new 1095 CCGT plant near Surat (Joseph 2005). In both cases, power off take will likely involve energy traders like the PTC and sales to SEBs would be minimal (ORF 2005).

5.7 Organic approach

Encouraging more CPP and distributed generation is inherently a more organic and less centrally-planned approach. This alone carries political liabilities as it reduces the government's ability to control and reward constituents, both through cheap power and employment. However, this is balanced by the political clout of the industries that have fought to acquire this access to the market. From an efficiency standpoint, the advantage to the CPP approach lies in the close matching of capacity with those who most need it and are willing to pay for it. The actor with the best information about demand and its value are the industrial users themselves and this would eliminate the transactions costs involved in delivering the right level of service by the GUVNL. The disadvantage is that the system can suffer from having haphazard and unplanned capacity, which taken together may be less efficient than an optimally planned system. However, the "centrally planned sector" requires huge amounts of reliable data on both the supply and demand side as well as a massive public guarantees to investors to motivate the funding. This is exactly the approach that has failed to deliver adequate power supplies in India over the past 20 years. Small-scale, distributed and leveraging excess capacity from CPP can start to overcome the capital investment shortcomings of government-owned monopolies dominating the ESI.

5.8 Encourages competition in all parts of the ESI

Another important effect of more CPP in the Gujarat system is that it would increase pressure on the GEB at every stage of the ESI. In distribution, the GUVNL would face competitive pressure to supply newly private distribution companies, especially if the same private distributors build their own CPP as baseload or for peak periods. One possible scenario is described by Pamanaban, a private power finance consultant:

> "The electricity boards will suddenly find in the next three years that they have no demand for the electricity produced or bought by them and they would be under severe pressure on tariff because of market factors. The bureaucracy will be faced with market-related realities and if they do not cope, one will find that their establishment collapsing over the next five to ten years." (Padmanaban 2003)

More CPP in the Gujarat system would provide a backstop price for industrial power users, and thus force the GUVNL to compete for industrial business. One likely outcome is that the GUVNL, with a informational and technical advantage over local power distributors would be able to cherry pick the larger loads and lower prices just below the level a CPP would need to enter the market. This is exactly the response that the regulator should expect and is one way in which the GUVNL will maintain market share. The US power system experienced a similar pattern in the early part of the 20th century as the large urban utilities spread to the suburbs and rural areas by picking off the largest, most lucrative loads to prevent the local electricity cooperatives from reaching viability. However, now for the first time the GUVNL will have to meet commercial targets for service and quality because companies, even smaller firms, will have a choice of supply options.

More captive power also encourages optimal use of existing assets. It is estimated that the current capacity of captive plants in India is drastically underutilised, with an average plant load factor (PLF) of only 41.5 percent (CEA 2005). This figure does not include the small and medium size diesel gensets and plants under 1MW that are used in many small manufacturing plants and for back-up supply. One way to increase the use of existing capacity is to increase the incentives for plant to run, in this way at least 1000MW of extra capacity could be brought online in India almost immediately, albeit with high marginal costs, as much of this is fuelled by expensive liquid petroleum products. Increased wholesale power trading and direct sales to distribution companies would act as a market pull for captive plant owners and simultaneously close the current supply gap.

5.9 Reduces Transmission Investment

The added advantage of having generation closely linked with industrial load and distribution companies is that total transmission investment will be lower. Certainly more transmission investment is needed to enable long-distance power trading and to help keep the grid stable, but the close proximity of generation capacity to end users will serve to reduce grid stress and the need for new transmission capacity to evacuate power from large, centralised power plants.

The other benefit that current captive owners point out is that CPP plants help to stabilise the grid in the local area by providing voltage and reactive power support. This support also reduces the need for more transmission investment by the GUVNL. The ongoing disagreement over the validity of the CPP voltage support is the crux of the issue currently before the GERC, and is covered in more details in Section 5 of this Chapter.

5.10 Policy Indicators from the Central Government

The Ministry of Power has published the National Electricity Plan in February of 2005 with a section dedicated to captive power. It builds on the EAct provisions that give liberal support to CPP "with a view to not only securing reliable, quality and cost effective power but also to facilitate creation of employment opportunities through speedy and efficient growth of industry." The MoP goes on to specify that group captives are also needed for the "efficient expansion of small and medium industries across the country would lead to creation of enormous employment opportunities." (MoP 2005)

The second justification given for CPP encouragement in the policy document is that "a large number of captive and standby generating stations in India have surplus capacity that could be supplied to the grid continuously or during certain time periods. These plants offer a sizeable and potentially competitive capacity that could be harnessed for meeting demand for power." Although they would be competing with IPPs, the continued shortage of peak power is likely to provide commercial space for all players.

The policy also recognises the need for CPPs to have open access to the grid, as stipulated in section 30 of the Act. It calls for access to be given on a "priority basis" and for "appropriate commercial arrangements to be instituted between licensees and the captive generators for harnessing of spare capacity energy from captive power plants." The plan then leaves the implementation in the hands of the state regulatory commissions to decide on commercial arrangements and determine tariffs for CPP (MoP 2005).

These are positive developments for CPP promoters and have been further supported by a Power Ministry plan to open up the sector to more private investment by allowing build-own-operate (BOO) developments, which would set up companies as entrants into the not only the generation market, but also as suppliers directly to distribution companies. Further, the merchant plant builders could combine this investment with a distribution company holding and take advantage of vertical integration economies of scope. The Ministry is pushing for a multi-buyer model to avoid the problems encountered in Orissa (Energyline 2005).

5.11 Implications of Increased CPP

The addition of more CPP as power suppliers in the Gujarat system has a number of economic and political advantages, but would undermine the GEB's monopoly position in generation and would change transmission and distribution markets by providing power for wholesale trade or direct purchase by a distributor. The most obvious criticism of implementing the EAct to enable CPP market entry is that it will strip GEB of needed resources. The counter argument is continuing to protect the GEB from market pressure has proven to be a recipe for fiscal and service shortfalls.

CPP entry into the generation market would begin to create a competitive wholesale power market without the political upheaval or blanket privatisation that was experienced in Orissa. The bottom-up approach recognises the political economy of the Gujarat situation and the limitations of the approach used in the 1990s, which encouraged IPP entry and a single buyer model. With high hurdle rates, the IPP investment was only viable if almost all the risk was borne by the state or the SEB. The bottom-up approach would act to spread these risks across new entrants, but does so by giving new CPP and merchant plants a market and informational edge that the IPPs could not access, namely sales to industry and distribution companies. Reduced and better distributed market risk means that companies can finance new CPP capacity in a way that the IPP model could never motivate in India. CPP firms can take advantage of internal, guaranteed loads and new conduits to sell power on the wholesale market will give them ready access to capital.

6. Regulatory Requirements for 'Bottom-up' Model Reform

Industrial power plants and other captive generators are heavily dependent on regulatory decisions for investment signals. Even small changes in tax, surcharge or operation charges can make a CPP project uneconomic. The Maharashtra Electricity Regulatory Commission (MERC) states this relationship clearly in the 2005 draft tariff policy: "Experience has demonstrated that adequate compensation and appropriate commercial arrangements are essential for effectively harnessing the captive capacity."(MERC 2004)

In this section, regulatory policies now being considered by the GERC (and other state and federal regulators in India) are considered and economic impact sensitivity analysis is performed on each category of charges to better understand their impact on CPP commercially viability. Table 6 shows the assumptions that are used to create the model.

Table 6: Model Assumptions for CCGT CPP plant, 1000 MW for 2005

Model Assumptions	Units	Baseline	Low Case	High Case
% of Equity Investment	%	26.0	10.0	50.0
Import Duty	%	20.0	0.0	40.0
Surcharge	$/MWh	40.9	0.0	55.6
Parallel Operations Charge (POC)	$/kW installed	10.0	0.0	25.0
Gas Price	$/MMBTU	4.6	2.4	6.1
Plant Efficiency	%	50.0		
Required IRR	%	15.0		
Exchange Rate	Rs/$	45.0		
Equity Discount Rate	%	15.0		
Construction Costs	$/kW installed	580.0		
% of Plant Imported	%	25.0		
% of Output Sold	%	49.0		

6.1 Regulations Defining Captive Power

The first issue a CPP policy must address is the definition of what units will be allowed under the regulations. The MERC has defined a CPP as any plant using 51 percent of the output for its own use and allows for even less self use in special cases, such as periods of manufacturing shutdown or low capacity utilisations with a time limit of three years, renewable. This is a change from the pre-EAct definition that requires the CPP to use 75 percent of its own output (MERC 2004). The ruling will likely free up more capacity to be sold to the MSEB, to third parties or to the power trading companies for export. Gujarat has yet to issue a final decision on the definition of CPP, but a high limit would act to reduce the scope for third-party sales. The model used assumes that Gujarat based CPP will be able to sell 49 percent of power to other users.

6.2 Distribution and Wheeling Charges

The GEB has been granted the authority by the GERC to charge a distribution fee (i.e. wheeling charge) to users of its transmission network that want to send captive power plant output to associated industrial units; or more importantly charge those CPP owners that wish to sell excess output to third parties. The charges in use from 1998 are as follows:

Table 7: GEB Wheeling Charges (1998-2005)

	Wheeling Charges in Cash (Rs./kWh)	Wheeling Charges in Kind
HT Distribution	0.135	10 percent
LT Distribution	0.210	15 percent

(GERC 2005)

The GERC is planning on revising these charges, as shown below in Table 8. One of the most contentious parts of the current debate is who should pay for transmission losses and how should they be measured. In a system with high rates of theft, estimated at above 25 percent in some areas of Gujarat, it is difficult to differentiate between technical losses and power leakage through illegal connections. This problem is compounded by the complicacy of many of the GEB lineman and distribution officers.

Table 8: Proposed Wheeling Charges from the GERC, May 2005

	Wheeling Charges in Cash (Rs./kWh)	Wheeling Charges in Kind
HT Distribution	0.135	10 percent
LT Distribution	0.210	15 percent

(GERC 2005)

The last column remains controversial, as the “in-kind” charges were based on an internal GEB-sponsored study conducted from 2001-2004, which measured the aggregate losses in both the HT and LT parts of the Gujarat system. It found that 11 percent and 22 percent, respectively was lost from the system and thus bi-lateral contracts and anyone wheeling power would have to take this loss as their own as part of the total fee. For example, a company would supply 1.11 MWh of power, plus pay the cash charges of Rs 26 to deliver 1 MWh of power to another HT consumer. For an LT serviced client, the high imputed losses and cash charges make bi-lateral trades difficult and reduce the arbitrage margin for CPP plants looking to export power. High wheeling charges would make CPP ventures uneconomic and give the transmission and distribution companies little incentive to decrease losses, as they are compensated by IPPs and CPPs for those leakages on all non-GEB power sold. This problem was recognised by the MERC in its captive power order in 2005, which sets a much lower 2 percent wheeling fee and 5 percent transmission fee. The order also requires CPPs to sign a negotiated energy wheeling agreement (EWA) with the distribution licensee that takes into account time of day congestion considerations (MERC 2004). The MERC order is much friendlier to CPP operations than the current Gujarat regulatory orders and covers more aspects of CPP operations, thus reducing regulatory uncertainty. The GoG and may be forced to match the Maharashtra rules or risk losing industrial load centres to other states over the long term.

The GERC issued an important order on this subject on February 28, 2006 after several rounds of draft orders and hearings (GERCa 2006). The order specifies charges for transmission, wheeling, cross-subsidy surcharges and intra-state open access.

For transmission, the consumer is liable for two types of charges. First, is transmission loss in kind, or the difference in total energy that can be withdrawn post-transmission after accounting for line losses. This was set at 4.4 percent based on the average losses for the past three years from the high voltage grid system. Second, are the transmission charges in cash, with was calculated using the most recent GUVNL data on total expenditures on the transmission operations. In 2003-4 GEB spent approximately $200 million (at Rs45/USD) on all transmission related activities with a system generation capacity of 7587 MW. Thus, for each MW spent $72.50/day on transmission. This was set as the rate for long-term access users and short-term access users, defined as utilising the grid for 12 to 24 hours in day, are charged at 25 percent of this rate. Note that these charges are in addition to the postage stamp inter-state charges and apply to anyone transmitting power to an end user in Gujarat.

For wheeling charges, i.e. distribution charges, the GERC ordered that all distribution companies submit proposal for setting wheeling fees and deferred a final decision until after a review process. The final policy held that cross-subsidy charges would remain and that all open access transactions on the grid were liable for a $0.04/kWh fee to offset the gap between average tariffs, $0.0648 and the cost of supply, $0.104. For renewables, GERC ordered a continuation of the current policy of low transmission charges. All units of renewable energy sent through the grid are only assessed an in kind charge of 4 percent losses.

6.3 Transparent, open grid access for generators

The incumbent GEB and its eventual successor entities from the mandated unbundling in the EAct have a distinct information and technical advantage over captive power owners with regards to open access to the grid. In the simplest scenario, the GEB grid company can declare that the transmission system is overloaded, or that the frequency or voltage levels cannot absorb input from a captive plant. This uncertainty for the CPP operator translates into a weak market position and undercuts the economic viability of a CPP investment. As the regulator gains more information about the grid, the GEB can use its investment and maintenance outlays to "create" bottlenecks and leverage the grid to its advantage.

The goal of "transparency" has been the catchword of all the liberalised electricity markets in the OECD and thousands of man hours in the regulatory bodies have been spent trying to enforce the grid rules to allow access to third parties while maintaining reliability. It is safe to assume that the process will not be smoothly implemented in Gujarat, especially with the GEB standing to lose market share with every new CPP built. CPP owners may experience inordinate delays to access from the GEB successor transmission company, and the GERC may be constrained politically to deal with infractions in an aggressive manner. However, there have been signs that progress is being made. CERC has issued open access regulations for inter-state transmission, which would not only facilitate traditional bilateral transaction (negotiated directly or through electricity traders), but also cater to collective transactions in the soon to be operational power exchange. The bottleneck may be transmission scheduling by the Regional Load Despatch Centre. There is also some progress on the state level with the State Load Despatch Centres introducing nominal transmission charges for open access customers levied on a Rupee/MWh instead of Rupee/MW per day. In case of intra-state trades, if the State Commission has not determined the transmission charges, the charges for use of respective State network will be payable for the energy approved at the rate of Rs 30/MWh. Non-determination of the charges by the State Commission shall not be ground for denial of open access (CERC 2008).

The timetable for open access is dependent on the size of the CPP unit. Loads greater than 10MW are slated to have open access by the beginning of 2006 and smaller units, 5, 3, and 1 MW thresholds will follow 1, 2, and 3 years after the 10MW units respectively. The staged introduction of access is meant to protect the GEB from a sudden loss of revenue, but it also means that under utilised, smaller CPP assets new or in place cannot participate in power trading or direct sales and thus the power shortage will not be addressed as adequately as possible. It is estimated that "authentic" open access would liberate more than 1000MW of capacity into the Gujarat grid and thus provide more power for industry and domestic consumers. It also would provide a cash flow for small and medium sized enterprises (SMEs) who could provide power for variable costs plus a small fraction of fixed costs. Initial results show that access is working. In 2007, fifteen captive plants in Gujarat with 871.44 MW of capacity used the facility to wheel the electricity (FoR 2008).

6.4 Parallel Operation Charges

Most CPP plants chose not to run in an islanding mode, i.e. completely separated from the grid, and instead are connected in sync with the transmission system. This connection allows the CPP to run in parallel with the grid and share ancillary resources as well as providing back-up power if the CPP is shutdown. Further, the parallel connection enables black start capability for the industry CPP in the case of an unplanned outage. Until 2000, the GEB collected a parallel operation charge (POC) of 7.5 percent of demand changes corresponding to the installed capacity of the CPP. That year the GEB unilaterally moved to hike the charge to 50 percent of demand, only to have its actions quashed by the GERC in 2002 and all back dues were nullified. In 2004-5, the issue has returned as one of the most contentious cases now before the GERC with the GEB repeating its petition to implement a 50 percent parallel operations charge (POC) for all grid connected CPP. Case No. 256 / 2003 was recently ruled on (GERC 2004), but the end result brought little in the way of certainty to either side of the argument. The GEB held that because providing parallel operation capability to a CPP requires the same transmission and distribution investment as being the regular supplier of all the capacity needs of the industrial customer, that a 2:1:1 ratio (G:T:D) should be used to determine the POC. This ratio is based on the total costs to the GEB for installing and delivering a MW of power divided into its components. Essentially, the GEB wants to recover from the CPP owner all costs minus the energy charges.

Not surprisingly, industry groups, including the CII, came out strongly against the petition. They countered that CPP has emerged because of energy shortages and the “unavailability of quality and uninterrupted power” (Parikh 2003). Further, industry claims that captive generation eases the burden on distribution system and makes surplus power available to the state grid which improves reliability, power quality and adds reactive power to the system (CII 2004).

After months of hearings and deliberation the GERC held on June 24, 2004 that they did not have enough information about the costs of providing parallel operations to make a ruling on the petition, stating: “The Commission, as already indicated, has no settled views on the subject, since further study, data and analysis are necessary”. Thus, they ordered that a comprehensive study be conducted by an independent consultant to determine these costs (GERC 2004). This order has therefore effectively raised the uncertainty for CPP owners and will act to delay investment in the short term. To understand the POC effect on investment decisions and the possible long-term ramifications of a high POC, consider Figure 11.

Figure 11 Sensitivity Analyses of CCGT Project with Surcharges and POC

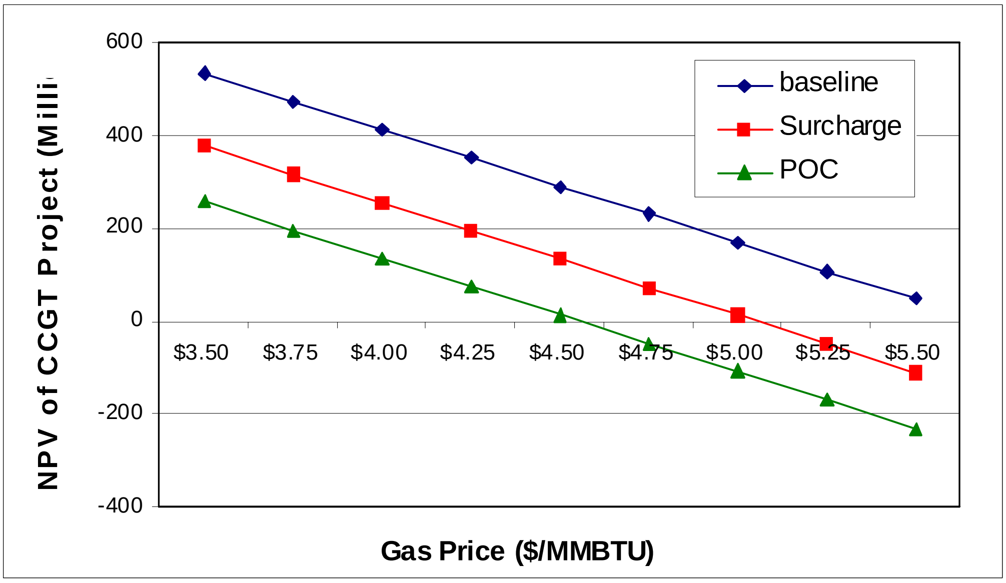


Figure 11 encapsulates several important variables that must be considered by a CPP owner. If we assume that the investment will take place with any project with a positive NPV, the hypothetical CCGT plant under the baseline assumptions will be viable at the predicted gas price of $4.56/MMBTU, indicated by the dashed vertical line. Under the same assumption, but this time adding in a 50 percent POC and other surcharges, the project would have a negative NPV. Under the range of likely delivered gas prices ($3.75 – $5.25/MMBTU), CPP would be severely disadvantaged by the POC mooted by the GEB. It would effectively push all projects into negative NPV territory and help to maintain the GEB's supply monopoly.

In Maharashtra, a much lower POC has been assessed and is in line with the MERC Tariff Orders. It requires that HT consumers with grid-synchronised CPP demand charges of Rs.20 per kVA per month, but only on the standby component, and then pay energy charges for power taken in excess of the consumer's contract demand (MERC 2004).

6.5 Ancillary service pricing

One of the key elements of the POC debate has been the proper accounting and charging of ancillary service provision. The balancing of reactive power in the grid is a constant management challenge for the grid operator, who must balance the system. To keep withdraws at low levels and to stabilise the grid, a charge is used for ancillary services on all generators and some industrial consumers. CPP have been at the centre of this decision by the regulators because of their undetermined role in reactive power balancing.

In Gujarat, the GERC has allowed reactive power to be included in tariff calculations and the GEB has claimed that CPP damage grid stability by using ancillary services without paying for them when connected in parallel. The industry has responded by arguing that CPP actually increase reactive power resources and often have to pay for inadvertent power transfers to a CPP operating in parallel thus they should not be charged for ancillary services like reactive power (CII 2004). The final decision on this question and the level of charges will impact the costs of the CPP and thus its financial viability.

6.6 Availability Based Tariffs to Encourage Demand Management and CPP Exports

The use of time of day pricing in India is not new, but it remains at a simple level of implementation, normally only having distinctions between peak and non-peak times for both industrial and small consumers. Smaller time blocks could be adopted for industrial consumers to better price each time period and futures, day ahead and wholesale markets could be used to reduce price risks for both buys and sellers. Without a well functioning wholesale market or open bidding mechanism in place for electricity generators and consumers, India has had to use time of day tariffs as an approximation. The Central Electricity Authority (CEA) has called for an availability based tariff (ABT) to be adopted nationwide since 1997 and pushed for it to be introduced in a phased manner. The CERC has now promulgated an ABT rule, which is intended to ensure grid discipline and also encourage grid reliability, efficiency and competition in the system at all levels. However, it must still be adopted by state regulators for it to come into practical force.

The use of ABT will encourage CPP owners to exercise internal demand side management (DSM) to better take advantage of higher power prices. For example, the CPP owner could shift factory production to off-peak hours to free up more kWh to be sold to the grid or third party buyer. The CPP owner is in the best position to make these decisions and can properly price the electricity versus the value of the power to the firm. In other words, the industrial owner has an information advantage that when repeated over the whole CPP owner pool, will free up more power during peak times and reduce prices for the power market and close supply gaps.

6.7 Unscheduled Interchange (UI) from Transco to Incentivise Power Stability

CERC defines unscheduled interchange (UI) Charges: “Variation between actual generation or actual [with]drawal and scheduled generation or scheduled drawal shall be accounted for through Unscheduled Interchange (UI) Charges. UI for a generating station shall be equal to its actual generation minus its scheduled generation. UI for a beneficiary shall be equal to its total actual drawal minus its total scheduled drawal. UI shall be worked out for each 15-minute time block” (CERC 2004). The CERC has set charges for all UI transactions based on average frequency of the time block and applies the following rates from April 2004, as shown in Table 9.

Table 9: CERC Unscheduled Interchange Rates

Average Frequency of Time Block	UI Rate (Paise per kWh)
50.5 Hz and above	0
Below 50.5 Hz and up to 50.48 Hz	8
Below 49.04 Hz and up to 49.02 Hz	592
Below 49.02 Hz	600
Between 50.5 Hz and 49.02 Hz	linear in 0.02 Hz steps

Note: Each 0.02 Hz step is equivalent to 8.0 paise/ kWh within the above range
(CERC 2004)

The GERC declared in its draft rules of February 9, 2005 that it plans to establish a clear regime for UI charges, reactive power and a grid management/scheduling charge (GERC 2005). In August of 2006, the GERC made a final ruling on UI charges (GERCb 2006) and decided to go with lower levels than suggested by the CERC. Each 0.02 Hz step is equivalent to 6.0 paise/kWh in the 50.5-49.8 Hz frequency range, and to 9.0 paise/kWh in the 49.8-49.0 Hz frequency range.

6.8 Clear surcharge rules and timeline for phase out

The GERC has defined the cross subsidy as: "…the difference between the cost of supply of electricity to a particular category of consumer and the tariff for that category. This cross subsidy element which is being recovered from the subsidising consumer category shall be recovered as a surcharge."(GERC 2004) GERC has also recognised the express intent of the 2003 EAct to encourage CPPs by exempting it from surcharges if the power is for its own use and the Act's provision to eliminate the cross-subsidy over time. To this end, the GERC has published a draft schedule for phase out shown in Table 10.

Table 10: Surcharge Removal Schedule

Year after introduction of open access	Surcharge as a percent of cross subsidy
1st	100 percent
2nd	75 percent
3rd	50 percent
4th	25 percent
5th	0 percent

(GERC 2004)

The actual rates to be charged have been published in draft form in 2005 as part of a discussion document (Table 11). As expected, the GEB has argued that high surcharge rates are needed or the Board's financial viability will be undermined by losing high paying industrial customers, while being forced to provide power to rural and domestic consumers that do not pay for the cost of the power. Industry has countered that the cross-subsidy "tax" is unfair to businesses and ultimately leads to job losses as input costs in Gujarat are higher than other parts of India and other manufacturing locations abroad.

Table 11: GERC Cross Subsidy Surcharge Draft Proposal, 2005

	Industrial Medium Voltage (11 KV)	**Industrial High Voltage (66 KV and above)**	**Traction Railways**
(a) Average Tariff of the Category (Rs/kWh)	4.21	4.21	5.10
(b) Pooled Power Purchase and Generation Cost (Rs/kWh)	2.13	2.13	2.13
(c) System Loss in Percentage	15.40	4.40	1.50
(d) Discounting factor for System loss (1 – C/100)	0.8459	0.9559	0.985
(e) Expected Pooled Power Purchase and Generation Cost (Rs/kWh) (b ÷ d)	2.52	2.23	2.16
(f) Wheeling Charges (Rs/kWh)	0.40	0.14	0.14
(g) Cross Subsidy Surcharge (a-e-f) (Rs/kWh)	1.29	1.84	2.80

Source: (GERC 2005)

For most CPP owners, this means that any cost advantage of supplying third parties would be wiped out by the surcharge in Gujarat, which was finalised at the flat rate of 1.80 Rs/kWh in a 2006 order (GERCa 2006). In Maharashtra, the MERC has defined the surcharge differently for CPP, and set the rate equal to the average tariff for HT loads minus the average tariff for all loads within that distribution licensee's area, lacking detailed studies, the MERC calculates the cross subsidy (additional surcharge) to be Rs1/kWh, but then goes on to encourage CPP sales further by reducing the fee to Rs0.25/kWh as to not "overburden" the CPP (MERC 2004). This balance has been derided by the MSEB and will likely be reviewed in the next 24 months.

The surcharge amount is the single biggest regulatory imposed cost for CPPs looking to sell power to third parties. The MERC level, about 14 percent of the Gujarat level, will likely be low enough for market entry of CPP capacity, but the Gujarat level, coupled with the other costs detailed in this section will stop most CPP sales agreements.

The larger question of how will surcharge levels impact SEBs has been taken up by Daljit Singh from Prayas Energy Group. He argues that low cross subsidies will "cripple" SEBs and will force an increase in tariffs for domestic and rural consumers, which he claims will cause a backlash against the policy (Singh 2005). In this respect, he has identified the main balance that must be maintained by the regulator, low input prices for industrial/job growth and the needs of the low income consumers to continue receiving low cost power. One way out of the fix is to improve the SEB's efficiency. Singh claims that SEBs that have competitive pressure, i.e. CPP, have not improved the operations and instead have continued to haemorrhage funds and do not respond to market forces the way private companies do. Morris echoes this point, when he details the financial ability of SEBs to survive on a cash basis from one year to the next, pushing the problem of insolvency into the future (Morris 2002). This is true in the short term, but both sets of arguments assume a static regulatory and state government response. The EAct fundamentally changes the dynamics in the industry by allowing players to leave the system and to buy power from anyone they want. Thus, even if the SEBs responds with complacency, the government has a strong incentive to continue reforms that did not exist before the EAct.

6.9 Electricity and Gas Taxes

The state electricity duty has been waived for all CPPs in Gujarat for power consumed by the owner, but the duty does apply to all third party sales at the rate of Rs 0.36/kWh. However, this is also true for SEB-supplied power and thus, it does not have a differential impact on CPP competitiveness versus the SEB supply.

For natural gas, the Indian Supreme Court has clearly ruled that on the central government will have jurisdiction on regulatory and tax matters. This will provide some level of regulatory certainty for prospective investors and will help CPP owners to better predict fuel costs. The Gujarat Government's planning documents concede the taxation point, but state planners envision the midstream gas grid being developed "completely by state support" (GIDB 2005) at a cost of $640 million in the next 15 years. Again, a state controlled gas distribution system may be a way to reduce fuel access for private power plants. Acting against the use of this tactic are the interests of the private developers, e.g. Gujarat Gas, Shell and Total, that will look to sell gas to the highest bidder and will demand reliable gas transmission capacity.

6.10 Need for Bi-lateral Electricity Trading Arrangements

Bi-lateral trading of electricity continues to pick up momentum in India in the wake of the electricity act. However, the nascent Power Trading Corporation is dependant on regulatory policy at the state level for reliable and reasonable tariffs for transmission access. PTC Chairman & Managing Director, Tantra Thakur, identified the state regulatory commissions as the biggest source of risk for his business model, as the wheeling charges and access questions have not been adequately dealt with by the commissions (Thakur 2004).

In Maharashtra, the MERC has left these matters to commercial negotiation, but has reserved the right to set norms in the future if needed. This approach leaves many of the details to be worked out by the contracting parties, but leaves the door open for contractual abuse and non-commercial instruments, such as "technical failure" by the distribution company to demand better terms from the power sellers or purchasers.

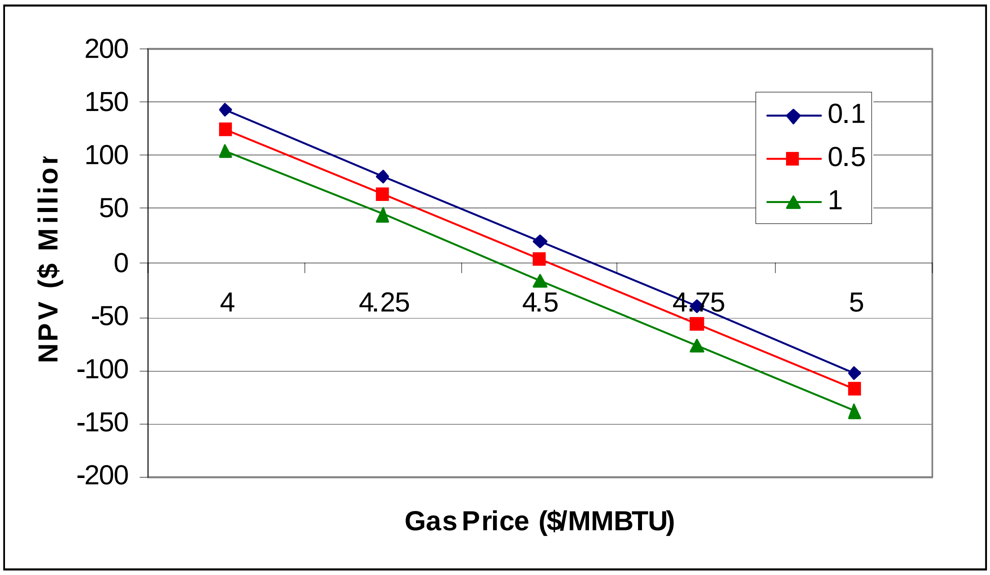
The Gujarat regulators will need to establish a framework for power trading to encourage private power generators to enter the market. Without a safeguard to protect CPP plants from contractual manipulation before and after terms are agreed, investors will be wary to count on third-party sales and thus the income stream from captive generators will be difficult to rely on for financing.

6.11 Captive Power Plant Equity Requirements

The Indian state has used capital controls and investment regulations to influence most sectors of the economy. In electricity, the government used changes in capital control regulations to encourage foreign investment in the wake of the 1991 reforms. Equity requirements fell to as low as 20 percent of project costs, and they allowed 100 percent foreign equity, but stated that Indian financial institutions could not provide a total debt component of greater than 60 percent per project (Energywatch 1998).

The debt to equity ratio remains an important policy tool of the Indian regulators, with discretion left to the SERCs, but coordinated by the Central Electricity Regulatory Commission. The Maharashtra Electricity Regulatory Commission called for a 70:30, debt equity ratio in its draft tariff policy (MERC 2004). In Gujarat, the regulators are discussing using either the current rate of 26 percent or increasing it to 51 percent to reduce the leverage of companies in investing in captive plants. On the face of it, the larger equity requirements would force CPPs to be only built by companies with long term benefits from self generation, as they can guarantee power off-take and support the capital expenditure with the price differential for the power and export income. However, this higher equity bar would discourage CPPs from entering the power market as surplus generators, as they would have a high capital exposure. Using the cost model developed for Section 4.3, it is possible to measure the relative impact of a higher equity requirement. The model inputs assume that equity rates are 15 percent and debt (bonds) cost approximately 8 percent, which is the rate for large and medium sized Indian industry with AAA ratings. The equity component is assumed to cost 3.5 percent as the risk free capital rate on the international markets plus and 11.5 percent as the risk premium/opportunity cost for Indian equity. Figure 12 shows the effects of the different policy choices.

Figure 12: CPP Project Finance Characteristics for Different Levels of Equity Investment



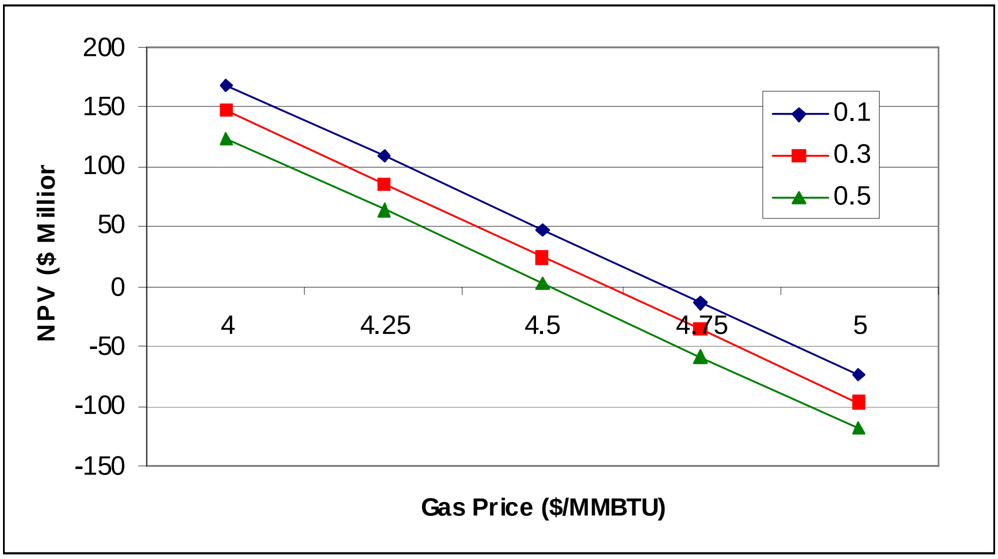
The vertical dashed line is placed on the assumed average gas price for CPP projects in Gujarat from 2005-2010 ($4.54/MMBTU). The top line indicates the NPV of a CPP project with a very low equity component, 10 percent and the bottom line the other extreme, a 100 percent equity stake. It is clear from this cost model that project viability is only marginally changed by higher gearing of the project. However, a more highly geared project does reduce the cost of borrowing if the company is able to obtain low bond rates with a AAA-grade for its corporate paper.

6.12 Capital Equipment Import Duties

The current tax for importing capital equipment for power projects is set approximately 40 percent with exemptions made for "mega power projects", i.e. those with capacities greater than 1000MW. It has been proposed by industry groups (e.g. CII, FICCI) that this threshold be lowered to 250MW. The industry groups are also lobbying to push the import duty lower as well, even for the small projects (5-250 MW). The Associated Chambers of Commerce and Industry of India (Assocham) has asked the Union Finance Ministry to bring down the import duty on goods required for setting up of captive power plants by 50 per cent in the budget proposals for 2005-06 to give a boost to the captive power sector. The request would put the new duty structure in the range of 20 percent instead of the prevailing duty structure that requires imported captive power plant equipment with capacities of 5MW or more to pay the basic custom duty of 20 percent plus an additional custom duty of 16 percent (ORF 2004).

For CPP projects, import duty policy can have a significant effect on total project costs, as two key components, gas turbines and steam generators, are normally imported. Extending the cost model from the previous section, and assuming a 40 percent duty on 25 percent of the plant that is imported, the cost of the construction is increased by nearly $40/kW. Figure 13 shows the effects of the duty on the project economics, holding the other assumptions static.

Figure 13: CPP Project Finance Characteristics for Different Levels of Import Duty



The effects of the duty on the NPV are comparable to the changes caused by equity requirements. Under the assumption that 25 percent of the plant has to be imported (it may be higher for some CCGTs), a 40 percent duty change from 10 percent to 50 percent will cause approximately a $45 million swing in the NPV or enough to stop some viable projects at higher gas prices.

6.13 Power Purchase Requirements

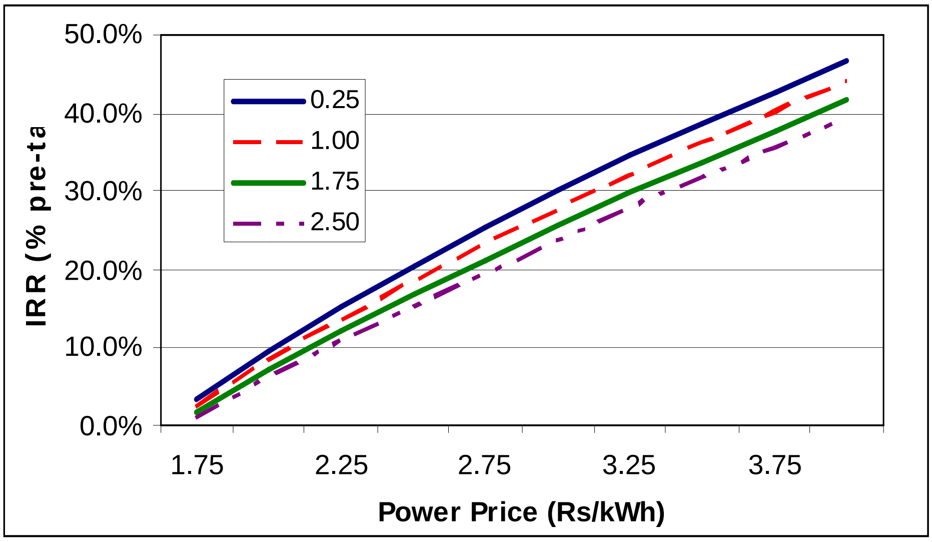
The GERC has proposed a renewable and cogeneration requirement for all distribution companies of 2 percent in 2004-5 increasing by 0.5 percent each year to 2010, at a level of 5 percent. The policy, if implemented as drafted, will give a strong incentive to CPP owner to invest in cogeneration to take advantage of the purchase requirement. Renewables are already guaranteed to be purchased when available, a policy confirmed by the GERC draft on power purchase requirements: "generation of electricity at zero cost shall get preference"(GERC 2005). The same draft report also calls for a "mechanism" to consult between generators, the newly created and separate State Load Dispatch Centre (SLDC) and the distribution licensee(s). The SLDC will be responsible for "meeting power shortages; for providing spinning reserve or frequency control capacity etc. and mechanisms for spot or bilateral purchase or overdraw/under draw of active and reactive power by distribution licensees" (GERC 2005). The report also lays out the principle of least costs supply, or merit order purchase, by stating: "the criterion of power purchase will in general follow the principle of least cost commensurate with power system stability, system voltage, frequency profile and system losses" (GERC 2005).

This signal to build a new operational structure is a positive sign and ultimately necessary for CPP owners and power traders, such as the PTC, to function within grid. The GERC is showing its intention to set up power markets that would be coordinated on a real time basis by the SLDC;

however, as has been found out the hard way in many western countries that have created power markets, the details are often difficult to make work smoothly. This policy intention from the GERC is a step in the right direction, but will take several years of hard negotiating with the incumbent GEB-divested firms to make the system commercially functional. The GERC will have to build up significant new capacity to monitor this market and develop detailed regulations to send signals to the market players and prevent abuse by incumbents.

The power purchase requirements and the power price that CPP will receive during periods of high demand have a dramatic impact on the financial performance of the project. Figure 14 displays the change in IRR as the price of power increases.

Figure 14: CPP project IRR sensitivity to power price (RS/kWh)



The steep slope of the lines, each representing a different surcharge level, tells the same story: low prices enforced on the CPPs will stop investment in surplus capacity. However, in some demand periods, the CPPs may be willing to sell excess power at near marginal cost and would get a higher price during peak hours. The figures above represent the returns on average power prices. The goal for a CPP would be to sell some or all of its excess power on long-term contracts to manage the price risk.

6.14 CPP Policy Effects Summary

Section 6 has detailed the different policy elements that will have the greatest impact on CPP viability in the newly reformed Gujarat power market. Figure 15 shows how several of those factors will change the levelised price of power from a CPP project by disaggregating the constituent elements of the levelised cost.

As is the case with most natural gas-fired power plants, the fuel costs are nearly three quarters of the total price of each unit, while O&M and capital make up a further 15 percent. The remaining elements that are largely in the hands of the regulators are what will make CPP projects viable or put them at a competitive disadvantage to the incumbent generators. Figure 16 uses the base case as the middle line and looks at high and low scenarios for each variable as given in Table 6.

Figure 15: Influence of Policies and Fuel Prices on Levelised Costs of CPP Power; (Rs/kWh); percent of total

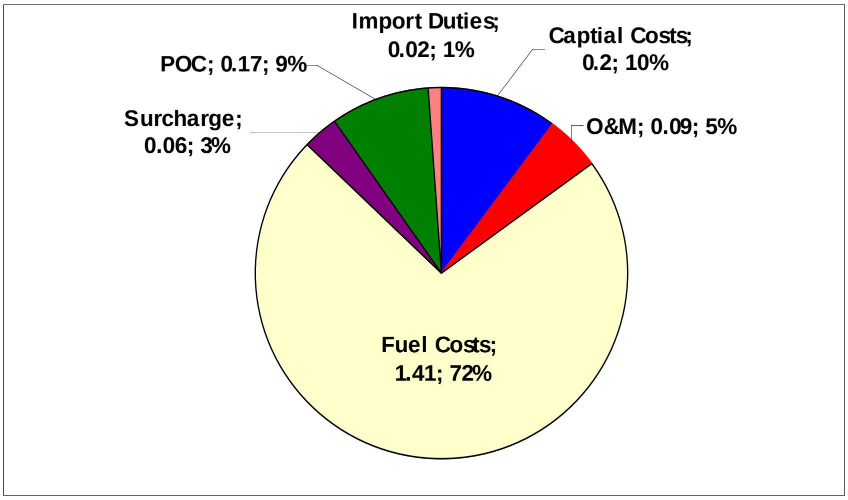
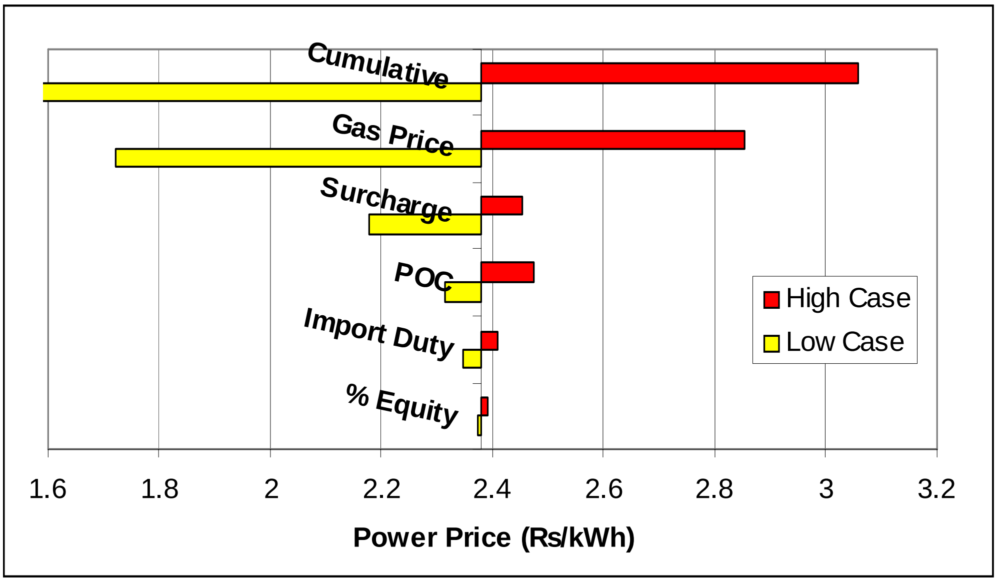


Figure 16: Tornado Chart of CPP Economic Factors, using 15 percent IRR



Without a doubt, the gas price has the largest role to play in determining CPP viability. Industries have long experience working on mitigating input prices and gas procurement will fit inside that remit. Long-term contracts, fuel price hedging, production shifting can all be used to reduce fuel costs. For state policy makers it is the remaining part of the pie, some 34 percent in this example, which requires urgent attention. The GoG and by extension, the GERC, will have a huge role to play in shaping the size of that piece of the costs for CPP promoters. Policy can be used to great affect to leverage local capital to meet demand or the incumbents can be overly protected – getting this balance right is the need of the hour.

7. Conclusions

The addition of more CPP as power suppliers in the Gujarat system has a number of economic and political advantages, but would undermine the GEB's monopoly position and would change transmission and distribution markets by providing power for wholesale trade or direct purchase by a distributor. The most obvious criticism of implementing the EAct to enable CPP market entry is that it will strip GEB of needed resources. The counter argument is continuing to protect the GEB from market pressure has proven to be a recipe for fiscal and service shortfalls.

CPP entry into the generation market would begin to create a competitive wholesale power market without the political upheaval or blanket privatisation that was experienced in Orissa. The bottom-up approach recognises the political economy of the Gujarat situation and the limitations of the approach used in the 1990s, which encouraged IPP entry and a single buyer model. With high hurdle rates, the IPP investment was only viable if almost all the risk was borne by the state or the SEB. The bottom-up approach would act to spread these risks across new entrants, but does so by giving new CPP and merchant plants a market and informational edge that the IPPs could not access, namely sales to industry and distribution companies. Reduced and better distributed market risk means that companies can finance new CPP capacity in a way that the IPP model could never motivate in India. CPP firms can take advantage of internal, guaranteed loads and new conduits to sell power on the wholesale market will give them ready access to capital.

This paper demonstrates the advantages of using CPP in a bottom-up model to change the demand and supply functions and introduce an element of real competition to the GEB. The conclusion that CPP and distributed power can be used effectively to help reform the electricity sector in Gujarat challenges the existing literature and extends Morris' argument to include more private operators in all parts of the ESI and not a wholesale shift to private ownership, which would present a number of political hurdles and create intense opposition to ESI reform.

The policy of encouraging captive power will be beneficial in the long run for the economy, but will require significant adjustment of the current SEB led ESI and some continued payment by industry to ease this transition. For industrial and commercial consumers, that will mean continued cross subsidies, but with the political deal that they would be reduced over time and become more targeted to reduce their growth. This would then in turn lead to "higher investments in captive generation as more and more industry consumers would tend to opt out of the SEB net" (TNN 2005). Ultimately, this pattern of ESI development would necessitate tariff rationalisation where the cost of servicing power is reflected in the power tariffs.

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