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Institutional barriers to commercialisation of wind power in India

The case of Gujarat

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Summary

Institutional support for encouraging renewable energy technologies in India, is strong at the state, the national and international levels. Within Gujarat a range of underlying drivers and more explicit policies and incentives have encouraged private investment in wind power. The Gujarat Electricity Board is financially and operationally weak. Constrained by a range of factors they are unable to meet increasing demand for power and future supply is likely to come from private power producers, increasing the overall cost of power. Inadequate investment within the transmission and distribution system further reduces the reliability and quality of supply to consumers. Industrial consumers must subsidise agricultural consumption, yet suffer an increasingly poor service as a result. Therefore an increasing number of industries are investing in self-generation including wind power thereby further reducing the GEBs revenue.

The performance of wind power projects installed within Gujarat has so far been disappointing, and objectives for reducing the cost/kWh of wind power not realised. Initial problems relating to manufacturing; operation and maintenance of wind turbines have been reduced as experience has been gained. Yet a number of factors continue to constrain the commercialisation of the wind power industry in India, this paper argues that primarily these are institutional in character.[2]

Keywords: Wind power; Private power production; institutional constraints; Gujarat, India.

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[2] "Institutional" is used in reference to the bureaucratic and political framework in which activities relating to the India power sector are carried out. Here a number of institutional barriers to wind power development are identified and primarily relate to the inexperience of agencies and inappropriate policies, for dealing with wind power projects.

Contents

1 Introduction

India is the world's fourth largest investor in wind power and the largest wind power producer in developing countries with 992 MW of installed wind power capacity in September 1998. This paper concentrates on wind power development in Gujarat, which in 1986 was the first Indian state to install a wind power project, and currently has the second highest installed capacity of any state.[3] Examining the history of wind power development in this state provides useful lessons for policy-makers wishing to promote the successful development of the wind power industry in India.

Since liberalisation of the generation sector in 1991, there has been a considerable degree of institutional support at the state, the national and international levels for encouraging private sector participation within the wind power industry in Gujarat. A number of incentives have been provided, these have stimulated a significantly high level of investment within wind turbines, but not led to a decrease in the cost/kWh of wind power. Rather the performance of projects has been disappointing and although solutions to some of the earlier problems such as inadequate level of skills, have been found, a number of factors continue to constrain the commercialisation Gujarat. This paper argues that the institutional framework and support mechanisms for wind power have themselves served to create barriers to the successful development of wind power in Gujarat. Primarily these relate to: the institutional complexity within which potential wind power developers must act; the structure and regulation of the GEB (Gujarat Electricity Board); and the fiscal incentives for capital investment.

[3] As of March 1997 the installed capacity of wind power in Tamil Nadu was 675 MW (Central Board of Irrigation and Power, 1997a).

2 Institutions involved in promoting renewable energy in India

A range of institutions involved in promoting renewable energy in India. These are found at the state, the national and international levels.

2.1 Ministries and agencies at the national level

The dissemination of technologies for improving the efficiency of utilisation of biomass resources for cooking requirements has been a central part of Indian rural development since the late 1940s. A rural energy crisis that resulted from inappropriate policies for development and market failure during the 1970s led to greater emphasis on existing and potential use of renewable resources for rural energy use. This became translated into policies at the national level in 1981 through establishment of the Commission for Additional Sources of Energy (CASE). As part of the Union government in 1982, the Department of Non-Conventional Energy Sources (DNES) was formed. Aiming to stimulate rural development, policies were introduced to promote the decentralised use of renewable resources through providing subsidies directly to renewable energy users (Shukla, 1997).

In 1992 the DNES became the Ministry of Non-Conventional Energy Resources (MNES), making India the first country to establish a ministry specifically for creating policies, strategies and implementation plans for promotion of renewable energy. Initially different departments dealt with individual technologies, in 1994 the MNES was restructured into three main divisions wind power being dealt with by the Power Division[4]. Activities undertaken include resource potential assessment; research, development, demonstration and commercialisation of renewable energy technologies; promotion of local manufacturing capabilities; institutional capacity building and human resource development as well as; design of financial incentives and project financing mechanisms. (MNES, Annual Report 1996-97).

A number of other national institutions are involved in promoting RETs, namely the Planning Commission, the ministries of Agriculture and Rural development; Science and Technology; Biotechnology and; Environment and Forests. Most of these government institutions are also represented at the state level. Wind power projects are also subject to the Central Electricity Authority (CEA) which is responsible for setting national policy and planning objectives for the power sector and the Ministry of Power (MoP) which establishes the rules by which these are carried out.

The Indian government expresses strong commitment for sustainable development. This is reflected by the large number of institutions and policies for encouraging research into environmental issues and diffusion of RETs. However this has not been translated into more

[4] The Power division also deals with cogeneration; small hydro and grid connected solar PV. The Rural Energy Groups I and II deal with energy from biomass technologies; technologies used for water pumping; solar thermal and PV lighting applications. The Urban and Industrial Energy Division mainly deals with energy from waste and conservation issues.

stringent environmental regulation on coal combustion. This is limited to statutory requirements on the minimum height of chimneystacks to reduce local deposition of ash (Ministry of Environment & Forests, 1994).

The Rural Electrification Corporation (REC) was established in 1969. Initially limited to financing energy projects for water pumping, it now distributes funds primarily provided by the World Bank, for village electrification on an area-wide basis directly to the State Electricity Boards (SEBs) whose financial viability is assessed according to World Bank guidelines. However economic viability of projects are assessed according to the wider social benefits and lower interest rates set accordingly. Although the MNES and the REC are supposed to co-ordinate with each other, in practise they have relatively little interaction, preventing a more integrated rural energy planning approach. Similarly the divisions within the MNES for different RETs also hinders this (Monga, 1997).

2.2 The Indian renewable energy development agency

The Indian Renewable Energy Agency Limited (IREDA) is a public sector undertaking, established in 1987 by the MNES. The main role of the agency is to promote, support and extend financial assistance to renewable energy projects. Funds are operated through a revolving fund to assist producers, manufacturers and users of renewable energy technologies. IREDA channels multilateral and bilateral funds primarily provided by the World Bank, the Asian Development Bank, DANIDA, the Netherlands Government and the Swiss Development Co-operation. "Soft" loans (lower interest rate loans) are offered to stimulate investment in renewable projects, technical guidance and project assistance also being made available. By 31st March 1997, IREDA had sanctioned 918 renewable projects totalling loan commitment of Rs1703 crore (IREDA, 1997a).

All types of borrowers are eligible for financial assistance except the SEBs[5] and Government Departments. Under World Bank guidelines, wind power developers may receive IREDA funds at a 16% interest rate (0.5% higher than the rate which IREDA procures funds) for a maximum period of 10 years. 100% of the equipment costs may be provided and up to 75% of the project cost, the promoter providing the remaining 25%[6] (IREDA, 1997b).

2.3 International development agencies

Following on from the MNES wind-mapping, monitoring and demonstration projects, the World Bank through ESMAP (the Energy Sector Management Assistance Programme) undertook a site-specific pre-investment study to assess the commercial viability of wind projects. ESMAPS objectives were to identify: Sites most likely to be commercially viable;

[5] SEBs undergoing restructuring are eligible in certain cases.
[6] In accordance with World Bank financing guidelines the following are awarded for projects:
Over US $5,000,000 - tendered for internationally through international competitive bidding (ICB).
Between US $5,000,000 - US $50,000 - Request for Quotation (RQF).
Under US $50,000- Established Commercial Practises (ECP).
Less than or equal to US $ 200,000 - Local Competitive Bidding.

project packages that would be "Bankable" and; measures for improving the local capabilities for technology development. As the World Banks first major RETs venture, US$78 million worth of credit was extended to IREDA. Included within this was US$13 million of concessional financing provided by the Global Environment Facility, as grant funding based on the environmental benefits that installed wind power would provide. The main objective of the World Banks Wind Farm Programme is to set up 85MW of grid connected wind power, and undertake activities for providing financial and technical assistance to prospective wind power developers (Naidu, 1997).

The Danish International Development Agency; DANIDA was the first international agency to show interest in the potential Indian wind power market, enabling the Danish manufacturer Micon to be the first to install wind power in India. In 1986 through a joint venture with NEPC[7] a 1.1MW demonstration wind project was set-up in Gujarat. There has since been a considerable level of interest by international manufacturers of wind turbines, keen to gain a share of the large potential market for wind power in India. Over 24 Indian companies have formed collaborations with companies from Austria, Denmark, Germany, the Netherlands, Belgium, Sweden and the USA. The UNDP and DANIDA are currently co-funding two centres in Guajrat and Tamil Nadu for turbine blade testing. (Interviews 1997[8]).

[7] NEPC-Micon is now a major manufacturer of wind turbines, earlier activities of NEPC are within the clothes; steel; food and airlines industries.

[8] Much of the information presented in this paper was garnered from interviews with over 80 people, conducted between September and December 1997. Relevant people were from the following:
Gujarat – Policy-makers within the Gujarat Government, from the Ministry of Energy and Petroleum; Ministry of Finance; Ministry of Non-Conventional Energy Sources; Ministry for Environment and Forests, the State Pollution Control Board; GEB Management; the AEC; GEDA; WEPA; NEPC-Micon and other manufacturers; GPCL; GIIC; industries investing in wind power and/or co-generation.
New Delhi - Policy-makers within the national government, from the Ministry of Power; Ministry of Finance; Ministry for Environment and Forests; the CEA; the Planning Commission; IREDA; the REC; the PFC (Power Finance Corporation); NTPC; NHPC; Powergrid as well as academic and legal experts.
New Delhi - International actors including members of the; Asian Development Bank; DFID; USAID; UNDP; and the World Bank.

3 Demands and constraints on the Gujarat power sector

Institutional support for industrial and commercial activities in Gujarat is strong, successfully encouraging relatively high levels of investment within these sectors. As such the Gujarat economy has experienced relatively rapid growth in recent years.[9] Industrial activities are related to the abundance of natural resources: Crude oil and natural gas provide feedstock for production of petro-chemicals, pharmaceuticals and dyestuff. The large agricultural sector provides the resources for textiles and food manufacturers. Although the majority of industries are clustered around the five major city areas in the South and eastern parts of the state, more dispersed centres of growth are emerging along the coast. Gujarat is well situated for exporting goods to Europe, Africa and the Middle East, as well as to western India, where the largest local market exists.

Given the large industrial and agricultural sectors demand for power within Gujarat is large. As of August 1997 the total installed capacity of the GEB was 4420MW of power, whereas the peak demand is 6511MW. The total available capacity for Gujarat is 6554MW[10], and through load shedding,[11] the GEB is able to "cater" for a peak demand of 5294MW (GEB, 1997b & GEB, 1997c). The ability of the GEB to reduce the demand-supply gap is constrained by a range of factors.

3.1 Uncertainty of fuel-supply

Indigenous coal production falls short of demand making fuel-supply a problem for most of India, yet the GEB is required to buy their coal, mined in the East of India,[12] from nationalised coal companies. The cost of coal is increased by the Railway Freight Pricing Policy, which charges high rates for deliveries of coal.[13] Heavily overburdened, the railways impose restrictions on the volumes of coal delivered, so the GEB cannot be certain of their delivery. Furthermore alternative energy resources are also limited; there is little hydro power potential; existing on and off-shore crude oil and natural gas supplies are considered national resources and reserved for production of liquid petroleum gas, and industrial feedstock (TEDDY, 1997).

3.2 Regulation and tariffs

The GEB is subject to legislative policies from both the central and state governments as set out in the Electricity Act of 1948 which states that policies set by national level ministries

[9] Gross State Domestic Product of Rs1, 15,550mn, is large relative to India's GNP of Rs19, 32,220mn. The per capita income is also large at Rs7,586 compared to Rs6,249 for all India (1992-93 levels).
[10] Power is purchased from central sector generators and the Ahmedebad Electricity Corporation, a licensee company supplying power to the Gujarat cities of Ahmedebad and Gandhinagar.
[11] Agricultural consumers receive unmetered power for a limited 8 hour period on a 12 hour rotational basis.
[12] Coal deposits are unevenly dispersed throughout India, and are concentrated within the Eastern states of Bihar, Madya Pradesh and Orissa.
[13] Constituting 40% of the total goods traffic, coal deliveries effectively subsidise other rail services.

must be implemented and regulated by the GEB. In practise the Gujarat government dictates most decisions and through the 1910 Act it can determine the price of power for consumers considered essential to the community. As in many Indian states it is mandatory for industrial and commercial consumers to cross-subsidise the power consumed by agricultural sector for irrigation (Government of Gujarat, 1995).

Demand from the agricultural sector is increasing thereby increasing the revenue losses from that sector. As the GEBs revenue worsens, and as sole distributor of power, so the already chronic under-investment in the transmission and distribution system continues. The reliability and quality of power supplied by the GEB is poor (blackouts; brownouts and fluctuating frequencies are commonplace) and worsening. Under capacities in supply, as well as in the T&D system are increasing the need for load shedding and organised power cuts.

Industrial consumers are forced to subsidise consumption by the agricultural sector, yet receive a poor level of service as a result. Since the late 1970s industrial consumers have been offered attractive incentives[14] to generate power for their own use. On-site generation provides industry with a more reliable supply of power and allows purchase of expensive utility power to be avoided. Thus increasing numbers of industrial consumers are opting for self-generation through which is further undermining the financial situation of the GEB.

Tariffs are supposed to yield a profit of at least 3% return on fixed assets, after any subsidies, yet by 1995-96 the rate of return was as low as -15.7%. Such large losses prevents the GEB from accessing funds from national financing corporations such as the REC. Provision of cheap and unmetered power supply, is said to be used by political parties for winning the agricultural "vote." It is widely believed that any attempts to remove power subsidies would provoke civil unrest, and a probable change of government Consequently although it is accepted that tariff reform is vital for improving the performance of the Gujarat power sector, it is widely regarded as being politically impossible. (Interviews, 1997).

3.3 Private power production

Financially very weak the GEB[15] is unable to access capital for investment in new generation facilities and it is likely that in the future all new generation is likely to come from the private sector.

In 1991 the Indian generation sector was opened to local and/or foreign private investors, ownership being offered on 30-year licenses. "Every developer's favourite state"[16], there is strong support for encouraging successful private participation in Gujarat, and a number of independent power production facilities are under construction. Since 1994 further incentives of reduced import duties and tax avoidance have been offered. In 1997 the Essar plant in Gujarat was the first IPP in India to begin operation. However expansion of the private power sector has been slower than expected, due to problems in negotiation of fuel-supply

[14] The captive power policy was introduced based on diesel fuelled generation.
[15] For the year 1995-96, SEB total losses were over $2 billion, double that for 1991-92, indicating that the financial performance of these utilities is declining rapidly.
[16] State of SEBs, 1997, PowerLine, 1(12): 30.

contracts[17]. Investors perceive the level of risk to be high given the political instability of the region and that power must be purchased by the GEB which is financially and operationally poor. Consequently very high rates of return are demanded making the cost of private power high. Purchase of IPP generation therefore further undermines the GEBs financial situation.

[17] The Indian government states that for private power projects all risk of fuel-supply must be shared by the IPP and the fuel supplier, the negotiation of fuel supply contracts has been a major constraint in the finalising of PPAs.

4 Wind power projects: Performance, experience and developments

This section outlines the development of the wind power industry in Gujarat since 1991. There has been a considerable level of investment in wind power, with over 146MW existing within Gujarat, of which 130MW is privately owned. The rate of wind capacity installation is indicated in figure 3.

The incentives for self-generation in Gujarat were extended to include wind power, coupled with incentives introduced by the MNES in 1993, manufacturing industries have been encouraged to invest within wind power for their own consumption. The constraints discussed previously may be considered as underlying factors leading to wind power development since: Wind power production can reduce reliance on expensive and uncertain supply of fossil fuels whilst meeting a much needed increase within generating capacity. Moreover industrial consumers through investing in wind power for self-generation are provided with cheaper power supply.

4.1 The Gujarat Energy Development Agency (GEDA)

Established by the Gujarat Government in 1979, GEDA was the first Indian agency to focus on supporting the development of renewable energy technologies. Its first director K.S. Rao recognised the potential of utilising Gujarats wind resources to increase power supply, without also increasing reliance on the import of fossil fuels. Rao conducted a number of studies to assess the potential development and possible constraints to wind power in Gujarat. Through pilot wind-farm projects the cost of wind power was estimated at Rs1.17/kWh over project lifetime. He concluded that this would allow significant cost-savings for industrial consumers that invested in wind power (Rao, 1991b, p.60). Rao was also very instrumental in encouraging national policy-makers to examine India's wind power potential (Interview, Director of GEDA, 1997).

GEDA facilitates private sector projects through: co-ordinating potential developers with local and international manufacturers; mobilising finance; clarifying contractual arrangements with the GEB for wheeling and buy-back of power as well as liasing with the Gujarat government, mainly over procurement of wasteland (GEDA, 1997b).

4.2 Poor wind power performances

Only a 12% average annual capacity factor[18] has been achieved so far, falling short of the 19% anticipated. Such low operating capacity factors[19], which have declined over the life of the

[18] Capacity factor is a measure of the ratio of annual average power output to the rated power of the turbine. It is important for calculating the cost of wind power from a turbine.
[19] Wind capacity factors in Europe are typically 20% at wind speeds of 6m/s rising as high as 45% at 9m/s (European Commission, Directorate-General for Energy, 1997, Wind Energy – The Facts, Vol.1, Technology Appendix p.69).

project in many cases, are indication that wind power development has not been as successful as initially expected (GEDA, 1997b). Ranging between Rs1.81/kWh up to Rs3.19/kWh, most wind-farms generate at a cost around Rs2.55. These rates are much higher than those estimated from the pilot projects, hence the objective for reducing the cost-effectiveness of wind power has failed. A range of factors constraining the development of wind power have been recognised, through experience within installation, operation and maintenance of wind power projects many of these have been reduced.

4.3 Inadequate wind mapping

The initial wind mapping exercise undertaken in 1983 was inadequate. Utilising only one anemometer for measuring the wind speeds at a single site, the whole coastal region was declared suitable. A more thorough and extensive wind mapping program was taken up in 1985 by the Indian Institute of Tropical Meteorology at Bangalore in conjunction with GEDA providing more accurate data of wind speeds and fluctuations at different heights and contours. The MNES is aims to improve upon this further through deploying sophisticated computer-aided technologies to provide a comprehensive Wind Atlas for India. (MNES, 1997).

4.4 Import of inadequate equipment

In the early stages of development of the wind power industry, foreign and in many cases inferior second-hand machines were purchased, notably from California. Developed for other systems, these turbines could not operate effectively within the Indian T&D system, which typically undergoes large fluctuations in frequency and where outages are common-place. Through a number of joint-venture projects, local manufacturing capabilities have been developed. As such turbines are now designed to operate within the specific requirements of the local system and operating problems occur less frequently. The MNES has set out to establish national policy guidelines, standards and specifications for local turbine manufacturers and imported components. Incentives will only be awarded to projects that comply with these regulations. Although many wind turbine parts including the blades and gearboxes are still imported blades, a number of components are now manufactured locally. The MNES claims as high as 80% indigenisation of wind power components (MNES, 1997a).

4.5 Lack of skills for operation and maintenance

During the initial stages of the wind power industry the number of people with appropriate skills and training for operating and maintaining the turbines effectively were limited. Consequently many technical faults often went unrecognised or repairs were ineffective. Maintenance was made much more difficult by the fact that most spare parts had to be imported. As the skills and many components for maintaining turbines are now locally available technical problems are more easily solved. Local manufacturers have begun to offer full packages providing installation, operation and maintenance services, with turbines sold.

4.6 Siting and planning approval

Proposed wind farm projects must gain approval from 12 different state government departments. This complicated application process is very time-consuming and ultimately incurs high costs relative to the scale of investment. In the past acquisition of non-government land has been difficult, requiring large taxes for conversion of agricultural land for other purposes. Recent acknowledgement that land on which wind turbines are sited can still be used for agricultural production has led to removal of these taxes. Yet a farmer may still object to transferral of agricultural land, which may take many years to resolve through the legal courts. (Interview with WEPA and Wind Power Developers in Gujarat, 1997.)

4.7 Difficulties in obtaining finance

Wind power development is one of IREDAs priority areas, however potential wind developers perceive difficulties in obtaining finance for projects. Involving numerous trips to New Delhi for negotiation of loans, is argued to incur too much time, effort and expense relative to the small-scale of investment (Interviews 1997). Recognising the difficulties of travelling to New Delhi, IREDA plans to establish regional offices throughout India. Another problem relates to the length of land leases. The Gujarat government only provides leases on land for a 15 to 30 year period. Whereas IREDA will only sanction loans for projects sited on land with a minimum 100 year lease (IREDA, 1997b). As IREDA loans are difficult to obtain, nodal financing agencies procure loans at the 16% interest rate, to be repaid within 10 years of the loan agreement. However through on-lending the benefits of these "soft"-loans are not received by wind power developers which typically are charged a higher interest rate of 18%, to be repaid over a 6 – 8 year period. The high interest repayments incurred during the initial investment period, increases the cost/kWh of wind power. Traditionally institutional finance is said to have facilitated the establishment of new technologies (Ahluwahlia, 1997). However wind projects are considered too small a scale of investment for these. Finance is procured by local financing corporations, which on-lend to wind power developers, again at higher rates of interest[20]. Therefore the mismatch between the characteristics of wind power projects and financing criteria of IREDA is a barrier to commercialisation (Interviews, 1997).

4.8 Poor transmission and distribution of power

Sited along the coast where local demand is very low, generated power from wind projects must be transported over long distances by the GEB. Frequent grid outages caused through overloading of sub-stations has meant that in order to reduce system failures, restrictions are imposed on the times at which wind power may be evacuated. Thereby preventing wind power projects from operating at their full potential capacity. Moreover industries requiring more reliable power will favour an on-site generation such as a co-generator, or diesel or gas-fired generators. (Interviews, 1997).

[20] For example the GIIC procures funds from the Indian Development Bank for Investment, which are on-lent to wind developers at a marginal profit based on ADB guidelines.

4.9 The wind energy power association

The Wind Energy Power Association (WEPA) was formed in 1995 to oversee the success of wind power in Gujarat and create a forum for collectively solving problems. There are over 35 members, membership only being made available to wind power producers of good repute, and the intent of improving the industry's performance. WEPA evaluates wind turbine manufacturers, and liase with the various ministries to enable implementation of government policy and; clarification of legal matters. Importantly WEPA provides a forum for discussion and dissemination of information to existing and potential wind power developers; planners and financiers. Moreover through WEPA, the wind power industry is more effectively able to lobby the government for continuing support.

5 The incentive mechanisms: Impact on wind power development

A range of fiscal incentives for investment within wind power has been provided at the State and National levels. Based on the success of wind power development within Gujarat and Tamil Nadu, in 1993 the MNES formulated guidelines for encouraging private wind power development throughout India.

Incentives suggested by the MNES

- A 5 year income tax holiday.
- 100% accelerated depreciation allowing companies to save 40% of the investment in wind power through foregone taxes.
- Duty exemption on imported technologies.
- Wheeling of power by the SEB at a charge of 2% of the power.
- Buy-back of power by the SEB at a rate of Rs2.25/kWh.
- Third-party sale of power.

The MNES can only suggest policy and it is up to the SEBs and the state governments to implement these.[21] In Gujarat a sales tax incentive was introduced, allowing a tax reduction on sales, worth 50% of the value of the investment of the wind project. These fiscal incentives to allow reductions in tax payments have been the most attractive incentives for companies with large profits. However these companies generally have little experience of the power generation business, and virtually no knowledge of wind power projects. It is also said that when profitable sales figures become known, industries will rush to set up a project before the end of the financial year. Consequently not allowing time for careful planning of projects (Interview, 1997). As the viability of wind power investments are so closely linked to company profits most projects are of very small capacity, often consisting of only one or two turbines. The dispersed siting of such a large number of small-scale projects makes it more difficult for operating and maintenance services to be provided.

The fiscal incentives allow up to 90% of project costs to be recouped within the first year. Furthermore the majority of benefits are received at the time of investment without any requirement to generate at all. Reported cases indicate that wind turbines have been installed without being connected to the distribution system. In one instance a fraudulent "wind developer" received tax reductions without bothering to install a single wind turbine (WEPA, interview, 1997).

The GEB will wheel the power to a designated factory at a charge of 2% of the power and will bank power for a period of up to 6 months. This allows industrial consumers to avoid the cost of purchasing more expensive utility power and the high electricity duty that must be paid in Gujarat.

As third-party sale is not allowed investors interested in generating power primarily for selling are deterred. Rather power must be sold to the GEB, which given its poor financial and

[21] Power projects over a certain value must be approved by the CEA.

operational records is not an attractive option. Particularly as it is only obliged to purchase power at a rate of Rs1.75/kWh which is lower than that suggested by the MNES. Compared to the purchase cost of conventional private power, which the GEB is obliged to purchase at an upward rate of Rs4/kWh, this is very low. However the GEB does not benefit from this as there is rarely any excess power, given the typically small-scale of wind projects whereas developers are mainly manufacturing industries with large power demands. The cost of GEB generation from coal is around 80-90paise/kWh making it much cheaper to generate power from coal than purchasing wind power or any alternative power (see figure 1).

However a study comparing the cost of wind power generation with coal generation[22] shows the cost of generation from coal to be much higher than the Rs1.75/kWh buy-back rate. At 12% discount rates and with a 10% inflation rate built in the levellised cost of coal generated power is Rs1.1/kWh project costs, with running costs of Rs2.25/kWh making the total Rs3.33/kWh. For wind powers these are respectively Rs3.23/kWh: Rs1.28/kWh and Rs4.52/kWh. The high initial fixed costs of wind power mean that interest rates are a significant component of the overall cost of wind power.

Contracts for the wheeling and buy-back of power are only awarded for a 3 year period. After which there will be considerable uncertainty as to how the power may be transported or whether any excess will be purchased. As the payback period on wind power investment has been estimated at 14 years (TERI, 1997) such short guarantee of contracts adds risk so raising the cost/kWh of wind power.

5.1 Status of the wind power industry in 1997

In 1997 interest within wind power investments dropped considerably. The Indian government proposed to impose a minimum tax on all company assets in August 1996. Subsequent to this announcement there was a sharp decline in orders for wind turbines, indicating that investment in wind power was encouraged primarily by the tax rebate incentive. Concern that operating performances of wind projects were so poor and, realisation that certain developers were abusing the incentives, led the Gujarat government to withdraw fiscal incentives for future wind power projects in 1997. Overall confidence within the wind power industry has declined, leading potential developers and policy-makers to view the potential commercialisation of wind power with a high level of scepticism (Interview, 1997). The confluence of declining levels of confidence within the technologies; withdrawal of incentives at the state level and; potential changes in taxation laws at the national level served to halt investment within wind power in Gujarat. This is indicated in figure 3.

5.2 Long term potential for wind power in Gujarat

As the overall cost of conventional power rises due to the growing proportion of more expensive private power, and the anticipated removal of subsidies on fossil-fuels makes conventional power more expensive, wind power will become a more competitive option.

[22] TERI (1997) p.60.

Moreover it is widely believed that the environmental regulation of coal combustion will be made more stringent in the future, increasing the cost of generation from coal. As the cost of transporting goods by land[23] is becoming more difficult and costly, industries are recognising the benefits of being sited near to the ports. Furthermore plans to import larger quantities of liquefied natural gas (LNG) from the Middle East, would further encourage industries to develop there. Subsequently centres of growth are likely to emerge in these coastal areas where wind resources are good, therefore reducing the need for transporting the power over long distances. Therefore providing the capabilities for planning; manufacturing; operating and maintaining wind turbines are maintained, wind power is likely to become commercially competitive with conventional energy once the institutional barriers are removed.

[23] Further to the undercapacity of the Indian railways, traffic congestion, sabotage and increasing frequency of truck driver strikes makes transport by trucks problematic.

6 Conclusions and policy recommendations

Problems of fuel shortage, an increasing deficit in power supply, and pressure from the industrial sector for cheaper power are underlying factors driving for the development of wind power in Gujarat. Experience within in operation, maintenance and siting of wind power projects has reduced many of the earlier problems encountered. Moreover through joint-venture projects with international turbine manufacturers, local manufacturing capabilities are more widely available. However policy-makers need to address a number of institutional factors if the development of the Indian wind power industry is to be successful.

Institutional complexity created by the large number of government institutions and agencies at the national and the state level, involved in setting policies and/or authorising wind power projects is a barrier for potential developers. Moreover renewable energy policies and promotional activities are often duplicated, or conflict to create uncertainty.

Renewable energy programmes need to be better integrated within a national energy-planning framework. A single Ministry for Energy for overseeing policies relating to the energy sector could enable this. The MNES should focus on co-ordinating and integrating renewable energy policies at the state level, ensuring greater clarity and cohesion of policies, support mechanisms and planning procedures at all levels. Similarly land leasing laws need to be reviewed and clearer national guidelines for siting of wind power projects suggested.

The fiscal incentives have attracted investors with little or no knowledge of the wind power industry (nor the power industry generally). Through greater emphasis being placed on capital investment within wind power projects and much less on operational efficiency, the incentives have inadvertently encouraged poor practises to develop. Moreover potential investors interested in wind power generation as their primary businesses are deterred by the terms of grid access.

Regulation should allow fair access to the grid, and third-party sale of power. Whereby wind power producers may negotiate directly with consumers for sale of generation. Paying a wheeling charge to the local distributor for transportation of the power.

However the declining performance of the T&D system will continue to constrain the development of the wind power industry. A high level of investment is urgently required for upgrading the T&D system. It is unlikely that this will be made available until the wider issue of structural and regulatory reform of the GEB is addressed, so encompassing the removal of any subsidies. Unbundling of the GEB, and sale of generation assets to the private sector would provide the GEB with the revenue for these improvements. Under a "Single Buyer" structure the GEB could continue to wheel power at a charge determined by an independent regulator. This would provide revenue for the GEB, and in the longer-term create potential for competition in generation.

A more competitive wind power industry should be fostered. This paper suggests that a mechanism similar to the Non-Fossil Fuel Obligation (NFFO) in England and Wales whereby contracts guaranteeing a premium payment/kWh for a minimum period of 10 years should be awarded through a competitive bidding process. This would ensure projects were more

carefully planned and designed and encourage developers to operate wind power projects at their full potential so reducing the cost/kWh of wind power in Gujarat. Moreover projects would more closely match the financing criteria of IREDA, enabling lower interest loans to be more easily obtained. NFFO contracts guarantee a premium payment per kWh for a 15-year period, which may be taken within 5 years of contracts being awarded. Contracts are highly sought after, and bid for competitively on the basis of the cost/kWh. Since the first NFFO round in 1991 the price declined from 11pence/kWh to around 4.5pence/kWh in 1994 (Mitchell, 1998).

WEPA should be encouraged to continue in its activities for co-ordinating and disseminating information between relevant stakeholders. GEDA should aim to encourage greater mobility of local finance through employing some of the more innovative financing mechanisms. Currently being advocated by international financing experts, these may take the form of bundling of projects or project leasing arrangements allowing risk to be more widely shared between shareholders.

7 References

Ahluwahlia, S.S., 1997. Renewable Energy: commercial and financial issues. pp.270-82 *In* Venkata Ramana, P. (ed.), *Rural and Renewable Energy: perspectives from developing countries,* New Delhi: TERI.

Central Board of Irrigation and Power (1997a), India, Regional List of Power Projects from Renewables, 1997.

Central Board of Irrigation and Power (1997b), India, Regional Map Power from Renewables, 1997.

European Commission, Directorate-General for Energy, 1997, Wind Energy – The Facts, Vol.1, Technology Appendix, p.69.

Government of Gujarat, Power Policy Document, 1995.

GEB, 1995, Annual Statement of Accounts 1995-96, 22.

GEB, 1997a, Administration Report, 1994-95.

GEB, 1997b, Statistical Data of the GEB, August 1997.

GEB, A Presentation on Power Scenarios: Present and Future.

GEDA, Activities and Achievements 1997.

Gujarat Energy Development Agency, Report provided by GEDA, August 1997.

Gujarat Electricity Tariff and Regulatory Bill, 1996.

Gujarat Industrial Investment Corporation Limited, 28th Annual Report, 1995-96.

IREDA, 1997a, Annual Report, 1997.

IREDA, 1997b, Renewable Energy Financing Guidelines.

Mathur, A. 1997. Development and deployment if renewable energy technologies in India: a technology policy perspective. pp.251-269. *In* Venkata Ramana, P. (ed.), *Rural and Renewable Energy: perspectives from developing countries,* New Delhi: TERI.

Ministry of Environment & Forests, Handbook of Environmental Procedures and Guidelines, 1994.
Ministry of Environment & Forests, Annual Report 1996-97.

Ministry of Non-Conventional Energy Sources 1997, Government of India, Annual Report 1996-97.

Ministry of Non-Conventional Energy Sources 1997b, Government of India, Renewable Energy, Opportunities and Guidelines for Investors.

Mitchell, C. 1995, Renewable Energy in The UK, Financing Options for the Future, Paper prepared for the Council for Protection of Rural England.

Monga, P. 1997, Institutional Barriers to renewable energy development in India, pp.293- 315, *In* Venkata Ramana, P. (ed.), *Rural and Renewable Energy: perspectives from developing countries,* New Delhi: TERI.

Naidu, B.S.K., 1997, Wind Power Development in India, pp.233-239. *In* (ed.) Venkata Ramana, P. (ed.), *Rural and Renewable Energy: perspectives from developing countries,* New Delhi: TERI.
NEPC Report, Business without Boundaries, Gujarat.

Paper presented by Gujarat Power Corporation Ltd., June 1997, "Seminar on Gujarat Power Scenario."

Paper provided by Gujarat Power Corporation Ltd., September 1997) "Private Sector Initiative in Power Sector in the State of Gujarat."

(Power & Energy Division) Planning Commission, Government of India, February 1997: "Annual Report on the Working of State Electricity Boards and Electricity Departments", Annex. 3.6 - 3.7, pp. 46 - 47.

State of SEBs, 1997, *PowerLine*, 1(12), September 1997.

Rao, K.S., 1990, Techno Economic Consideration of Wind Power Generation in Gujarat, GEDA, Vadodora, India.

Rao, K.S., 1991a, Role of Wind Energy in Developing Countries: A Case Study on India, GEDA, Vadodora, India.

Rao, K.S., 1991b, Wind Power Programmes in Gujarat, GEDA, Vadodora, India.

Shukla, P.R., 1997. Penetration of renewable energy technologies in India: an assessment of future trajectories and macro policies. Pp.84-96, *In* Venkata Ramana, P. (ed.), *Rural and Renewable Energy: perspectives from developing countries,* New Delhi: TERI.

State level: State Pollution Control Boards both in Gujarat and in Orissa, 1997.

TERI, August 1997, Economics of Wind Power, Impact of Fiscal Incentives, Study for the MNES.

TEDDY, TERI Energy Data Directory and Yearbook, 1997/98.

WEPA, Rules and Regulations of Wind Energy Producers Association.

8 Figures

Figure 1: Cost Structure of the GEB

	paise/kWh
Fuel	82.66
Power Purchase	47.41
Operation and Maintenance	6.91
Estimation and Administration	19.3

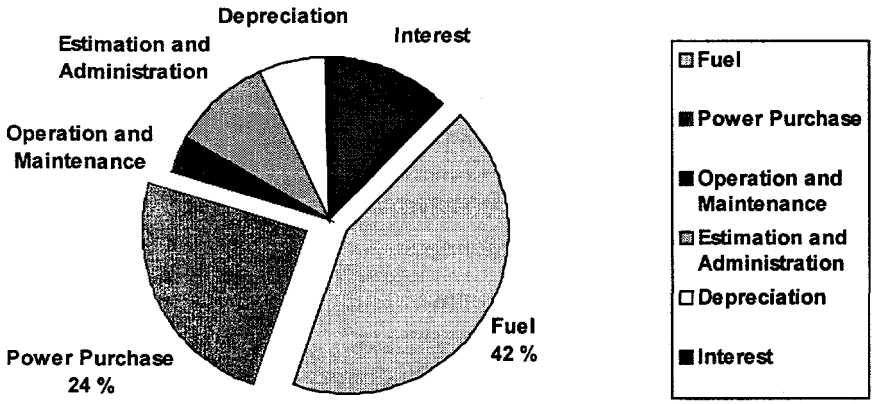

Figure 2: Number of agricultural consumers as percentage of total and agricultural consumption of power as percentage of total.

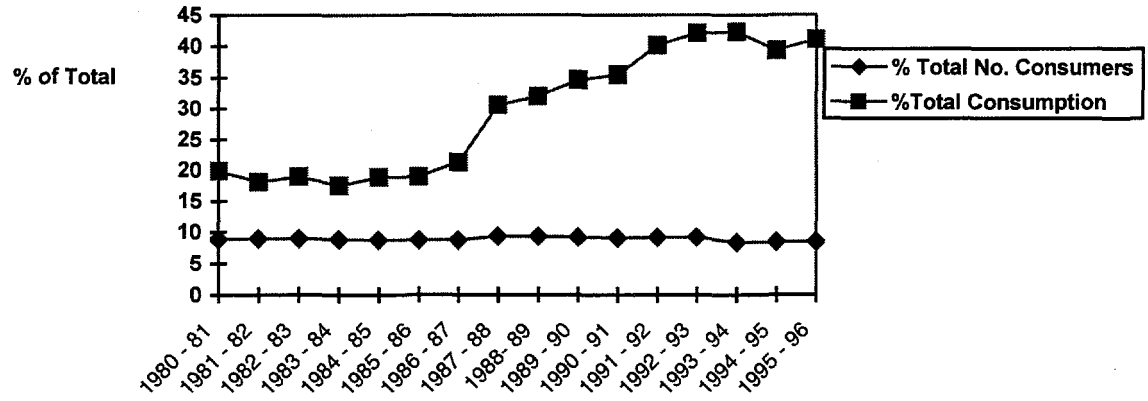

Figure 3: Installation of wind power capacity for Gujarat for 1990–1997.