INDIA'S

Electric Power, Energy Conservation and Non-Conventional Energy Markets — Opportunities for Canada

External Affairs and International Trade Canada

Canada

1. INTRODUCTION

This publication is designed to acquaint Canadian firms with the potential for doing business in India's electric power, energy conservation and non-conventional energy markets. It also provides practical information and advice on how to approach these potentially large markets.

The study gives an overview of the electric power sector market, the competitive situation as it relates to the provision of equipment and services, the institutional structure of the industry, the role of local representatives/collaborators and key contacts and assistance available both in Canada and India.

Activity in the emerging fields of energy conservation and non-conventional energy is also outlined in this report. Considerable opportunity for Canadian firms to supply goods and services in these areas already exists. Further, as India will no doubt be placing greater emphasis on developing these fields in the near future, the potential for Indo-Canadian cooperation in these areas should increase markedly.

Additional specific information or data relating to these markets may be obtained through the Commercial Section of the Canadian High Commission, New Delhi.

2. ENERGY AND ELECTRIC POWER OVERVIEW

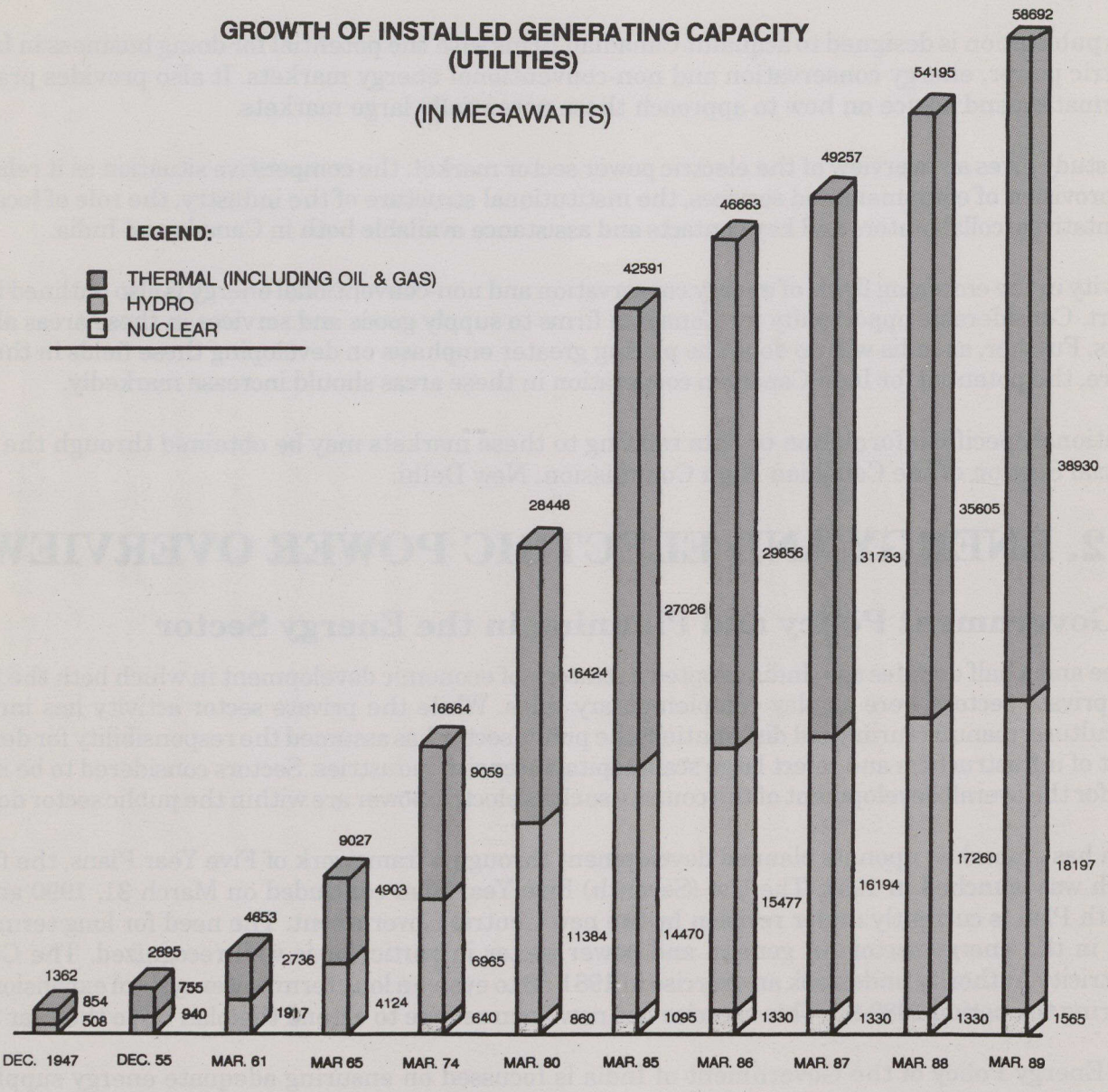
a) Government Policy and Planning in the Energy Sector

Three and a half decades ago, India adopted a strategy of economic development in which both the public and private sectors were to play complementary roles. While the private sector activity has included agriculture, manufacturing and distribution, the public sector has assumed the responsibility for development of infrastructure and select large scale capital intensive industries. Sectors considered to be important for the overall development of the country such as electric power are within the public sector domain.

India has embarked upon its planned development through a framework of Five Year Plans, the first of which was launched in 1951. The last (Seventh) Five Year Plan concluded on March 31, 1990 and the Eighth Plan is currently under revision by the new Central Government. The need for long term planning in the energy sector in general and power sector in particular is well recognized. The Central Electricity Authority undertook an exercise in 1981-83 to evolve a long term power system expansion plan covering the period 1982-95. This exercise has now been redone to extend the plan up to the year 2000.

The Energy Policy of the Government of India is focussed on ensuring adequate energy supplies at minimum cost, achieving self-sufficiency in energy supplies and protecting the environment from the adverse impact of utilising energy resources in an injudicious manner. The main elements of the Energy Policy which are reflected in the Five Year Plans include:

i) Exploitation of domestic conventional energy sources, i.e. coal, hydel, oil and nuclear power.
ii) Intensification of exploration for oil and gas to increase indigenous production.
iii) Management of demand for oil and other forms of energy.
iv) Energy conservation and management, with a view to increase energy productivity.
v) Optimising the utilisation of existing capacity in the country.
vi) Development and exploitation of renewable sources of energy to meet the energy requirement of rural communities.



vii) Intensification of research and development activities in the field of new and renewable energy sources.

viii) Organisation of training for the personnel engaged at various levels in the energy sector.

The Government of India has tremendous challenges on its hands and must make major progress in all of the above areas in the face of ever increasing demands for energy and critical funding constraints.

b) Electric Power Supply

The electric power sector plays a key role in meeting the energy needs of the Indian economy

(electricity provides 30% of commercial energy consumption). It is not surprising therefore that with severe shortages of power remaining a serious constraint to the economic growth investment in the power sector is a priority. The financial outlay for the electric power sector has been approximately 20% of total projected plan outlay in each of the last three Five Year Plans.

Achievements of additional capacity have varied widely under respective Plans — 49.4% in the Fourth Plan, 81.6% in the Fifth Plan and 72.3% in the Sixth Plan. Capacity addition in the Seventh Plan was targetted at 22,245 MW and the actual level attained approximated this level — a record achievement. The breakdown of the capacity added during the Seventh Plan was as follows:

	Plan	**Level Achieved**
Hydel	5541	4627
Thermal	15439	15144
Nuclear	705	705
Gas Turbines	560	1926

As the above figures reflect, the Government of India (GOI) has recently accorded increased priority on gas turbine plants particularly due to the shorter gestation period in bringing these plants into production.

The present electric power generating capacity of India is about 59,300 MW making it the seventh largest producer of electrical energy in the world. Of this about 39,300 MW (about 66.5%) is in the Thermal area (including Oil & Gas), about 18,500 MW (about 31%)in Hydro and about 1,500 MW (about 2.5%) in Nuclear power generation systems. State Government-owned State Electricity Boards (SEBs) accounted for about 68% of the total installed capacity while the Central Government-owned Corporations contributed about 28% and the private sector only a nominal 4%.

The generating capacity has maintained an average growth rate of about 10 percent annually over the past five years, though the yearly growth rate has fluctuated.

Growth in capacity has been achieved despite numerous obstacles. However, few experts in the sector are optimistic that India can expect to approach the ambitious capacity addition targets which have been set for the next decade. The capacity addition target for the Eighth Plan is 38,000 MW or over 60% of current installed capacity.

c) Demand Projections

The demand projections for electric power are phenomenal. Some studies project an incremental requirement of as much as 110,000 MW in the decade 1990-2000.

In order to meet a higher proportion of demand, improve the quality of supply and further extend rural electrification, the Government of India is planning to install 100,000 MW of capacity by the turn of the century. This would cost about US $ 150 billion at present prices and claim between 25% and 30% of total allocations in the Eighth and Ninth Plans (as noted earlier the allocation was about 20% in the Seventh Plan).

The industrial sector in India is the largest consumer of commercial energy, accounting for 60.8 percent; followed by agriculture (22.7 percent); and the domestic sector (16.5 percent). Within the industrial sector, the engineering industry accounts for the bulk of the total power consumption. Power intensive industries like iron and steel account for 15.9 percent and aluminium for 8.7 percent.

Despite the generation addition the rise in demand continues to outpace the supply by about 10-12 percent as is apparent from the power shortages and cuts encountered all over the country. The gap appears to be ever widening. This is attributed to low capacity utilisation, transmission losses, and delays in approving and commissioning new projects. The pricing structure which results in inadequate returns and the inefficient collection process must also be cited as underlying reasons for the funding constraints and the power gap.

Non-availability of power has a serious impact on the Indian economy. It renders production capacities idle, forces industrial units to close down, and results in wastages of capital invested and severe losses in employment and national income. It has been conservatively estimated that the Indian economy sustained a production loss of over $20 billion annually during the past decade primarily due to inadequate supply of electric power to meet the needs of the industrial and agricultural sectors. (Industry sources estimate a production loss of Rs.4,600 crores for a one percent shortage of power.)

d) Hydroelectric Power

India has one of the largest untapped hydroelectric generating resource in the world. Hydro generating potential at 60 percent Plant Load Factor (PLF) is estimated at 84,000 MW of which only about 18,500 MW capacity has been tapped, i.e. about 22% on a national basis. As a 60% PLF Factor for hydro projects in India is not realistic, tapped capacity is actually considerably less than 22%.

Realizing additions to hydro generating capacity is challenging, to say the least. Some 70 percent of the country's hydro resources are located in remote parts of the north and north-east of India and involve serious environmental and terrain hazards. There is thus a considerable access and engineering problem which raise the start-up costs for a form of power generation which even in more favourable circumstances involves above-average investment outlays. This may be especially true for the +6,000 MW of the hydro resource which is said to be of the mini/micro site variety. Considering that the average size of the current mini-hydro stations in India is less than 2 MW, commercializing the entire 6,000 MW may require several thousand individual project decisions — a major task in even a developed country and one requiring significant and sustained inter-organizational coordination.

In the case of larger hydro locations, the financial and technical burden associated with harnessing these resources frequently exceeds the potential of States, such as Himachal Pradesh and Uttar Pradesh, under whose jurisdiction fall water use rights. A further complicating factor is the long period of design and construction involved in hydro. This has acquired increasing significance with chronic power shortages which can be more quickly addressed by adding to thermal generating capacity. Finally, hydro projects require extensive environmental impact analysis.

Despite the challenges the GOI recognizes the importance of sustained development of its hydroelectric power potential. Its objective is to raise the share of hydel generation to total generation from 31 percent to 40 percent by the turn of the century. This would require the creation of 49,000 MW of hydel generation capacity.

e) Thermal Power (Coal-based)

India's coal resource is — like its hydro potential — one of the largest in the world. Estimates indicate that there may be 100 billion T of steaming coal in the country with 25 billion T of that deemed "proven". As noted earlier thermal power represents over 60 percent of India's current power generating capacity and all indications are that it will continue to dominate the Indian electricity picture. A stronger institutional setting and the shorter construction periods for thermal plants versus hydel plants lie behind the increasing amounts of money that have been spent on this form of energy.

However, thermal power is not without its problems. Unlike hydro — which involves no transportation of the basic resource — coal may have to be moved considerable distances, thus adding to costs (when not burned at mine mouth plants). Further the heat value of the generally low quality coal in India is largely below the standards for internationally traded steaming coal. Other problems and challenges include environmental issues such as ash disposal, liquid waste treatment etc.

Another technical shortcoming for the sector has been the switch to larger boiler units (from 110 MW to 200-210MW) which have taken longer than expected to operate at full capacity because of the desire to commission units before initial testing has been completed. Dealing with the pressure of energy shortages also explains why boiler overhaul and other maintenance has been performed increasingly less often. This, in turn, has given rise to an above-average incidence of plant malfunctioning. This cannot go on forever, however, and one can easily envisage a significant allocation for plant overhaul.

Other problems faced in the thermal sector include shortages of explosives at mines and overall delays in completing coal mines.

The combined impact of these various factors has been the relatively low capacity utilization at thermal generating stations — currently estimated at 56 percent. Indeed were it not for the inclusion in the data of the relatively high utilization rates recorded at thermal stations operated by the Central Government National Thermal Power Corporation, the level of capacity use would be significantly lower. Correcting this situation has become a central task in the thermal field. Canadian firms with capability relevant to this area should consult with the Canadian High Commission regarding specific opportunities. While funding is a major constraint for all activity in the sector, the GOI and SEB's recognize the significant returns through incremental investments in existing facilities to increase plant utilization. Opportunities for Canadian firms to provide services and equipment to thermal plans to increase productivity are considerable.

f) Gas-based Power

Natural gas as a source for generating electrical power is becoming an increasingly accepted alternative use of gas within the Indian policy making framework. The direct economic and opportunity costs to the Indian economy of India's increasing power gap combined with the short gestation periods for gas based projects are the reasons for the usage of gas as both a peak hour fuel and baseload fuel. The World Bank and India's Planning Commission to a large extent agree that power generation should be a large scale user of incremental natural gas supplies. The magnitude of investment required to convert new natural gas resources to electrical power is enormous. For example, estimates have been made that the cost of bringing 50 percent of the additional gas resources available to the turn of the century into the power generation sector would be in excess of $ 15 billion.

g) Captive Power Plants

Though most power in India is generated by specialized government-owned utilities, there is also some production of electric power by industry itself. However, at the present time, the installed capacity of captive power plants in the country is only about 5,000 MW with generation being only about 2,000 MW.

Large industrial companies such as TATA have led the way in the development of captive power projects to ensure supply for heavy industries such as steel operations.

Given the shortages and unreliability in supply, the Federation of Indian Chambers of Commerce and Industry (FICCI) has suggested to the GOI that private sector industry should be liberally encouraged

to set up captive power projects either for their own requirements or more economically, for general units on a cooperative/consortia basis with Non-Resident Indians (NRIs) investment where available.

The GOI's liberalization policy has now permitted access by the private sector to the funds of the public financial institutions to the extent of 50% of a planned project. This is a significant departure in policy hitherto pursued under which public financial institutions were barred from providing funds to the private sector for power projects. The FICCI envisages that cooperative power generation ventures could not only significantly contribute to stabilizing power supply but can even divert surplus generation to the National Grid with appropriate agreement with the State Electricity Boards for redrawing the supply during maintenance shutdowns, etc. FICCI is expected to actively lobby for appropriate changes in Government policy in this direction in the coming few months. One of the important policy decisions will have to be in the area of the degree of returns to private captive units who will likely not be willing to operate at levels of returns attained by the State Electricity Boards.

If private sector companies became more extensively involved in power generation, decisions regarding equipment/services procurement can be expected to be made more quickly than they are in the public sector organizations. This would be a positive factor as far as potential Canadian equipment/service suppliers are concerned.

h) Transmission

Transmission line projects continue to be accorded a high priority in the context of the need to evacuate power from the Central Generating Stations to the beneficiary States. The program for 1988-89 included construction of 2824 circuit kilometers (Ckt. Kms.) of 400 KV lines and 3195 Ckt. Kms. of 220 KV lines, along with the associated sub-stations.

The development of a National Power Grid has for some time been an important objective of the GOI. To achieve this objective, the strengthening and improvement of Regional Power Grids and their progressive integration through the setting of inter-State transmission lines and Central Sector transmission projects cutting across State boundaries is continuing.

Transmission Losses

Transmission losses are heavy and have averaged a significant 21.5%, with wide variations region-wise. Two of the main reasons cited for such losses are: poor maintenance and non-metering of transmission within states to detect pilferages. The GOI has recently decided to set up a National Power Transmission Corporation (NPTC) which will be made solely responsible for Power Grid Management. This step is expected to help reduce transmission losses. In addition, the NPTC will play a major role in the transmission of HVDC which has been installed in several areas and will be more prominent in the future. Several Canadian and other foreign firms/public utilities have been providing expertise to assist India in decreasing transmission losses and developing HDVC. Opportunities in these areas, particularly through collaborations/joint ventures can be expected to increase in the decade ahead.

i) Funding Requirement for Power Sector in Eighth Plan

Funding of projects targetted under the Five Year Plans has been a major constraint to say the least. For the Eighth Five Year Plan, the Secretary of Power recently estimated a requirement of approximately Rs. 106,000 crore to cover generation and transmission/distribution schemes in progress and to be started. However, budgetary allocations, multi-lateral and bilateral funds for projects scheduled for the Eighth Plan were estimated at approximately Rs. 82,000 crore. The funding shortfall will undoubtedly continue to impede the development of important projects in both the generation and transmission/distribution areas.

Despite the funding shortfall and the GOI's interest in taking advantage of concessional funding on bilateral projects, projects targetted for bilateral implementation are not being quickly approved. In fact, recently the Minister of Finance endorsed a proposal to restrict the usage of bilateral funds for new power projects. This was primarily due to an active local industry lobby and the perception that equipment imported under bilateral projects was not competitively priced. It remains to be seen whether the GOI will follow the proposed policy, given the extent of its funding shortfall and the inability of indigenous suppliers to complete projects in a timely manner.

3. COMPETITIVE SITUATION IN THE POWER SECTOR EQUIPMENT/SERVICES MARKET

a) Domestic Manufacturing Capacity

Over the years, India has attained a significant level of sophistication in its domestic manufacturing capacity. Today, India's manufacturing capacity ranges from steam turbines and generators upto 500 MW, to high pressure boilers, transformers upto 1000 MVA, and transmission and distribution equipment upto 400 MV. A wide range of electrical engineering products such as alternators, generators, transformers, switchgears, circuit breakers, insulators, conductors, capacitors, are also manufactured within India. India has also successfully exported its products to many countries around the world and has undertaken the establishment of overseas turn-key power projects, primarily thermal, against tough international competitive bidding.

The decision to set up a heavy electrical equipment manufacturing capability within the country was taken by the GOI as early as the 1950's. Today, domestic power generation equipment manufacturing is dominated by the giant GOI-owned Bharat Heavy Electricals Limited (BHEL) which manufactures both thermal and hydro electric generation, transmission and distribution equipment. BHEL is a 13-plant complex and has technical collaboration agreements with the USSR as well as other foreign manufacturers including Combustion Engineering of the United States (for boilers); KWU of West Germany for thermal generators upto 1000 MW capacity and related equipment; General Electric (USA) for gas turbines; Dresser Industries (U.S.) for control valves and pumps; and GE Canada for large hydro turbines. The GOI has made a policy decision to replace the 200/210 MW equipment by 500 MW installations for the thermal power plants. In addition to BHEL, there are several other manufacturers such as Crompton Greaves and Hindustan Brown Boveri. BHEL's share in the country's installed capacity has increased rapidly and nearly 60% of India's present generating capacity has been contributed by BHEL sets. About 80% of the Seventh Plan additions totaling 22,245 MW have been provided from BHEL sets. BHEL annual capacity currently is: Hydro - 1200 MW; Gas-based - 500 MW; Diesel - 300 to 500 MW; and Thermal - 1500 to 1800 MW.

The market potential for power equipment and services in India is very high, as the installed generation capacity is far below the level of capacities in most of the developed countries. Against the per capita consumption of electricity of 5,000 units in Japan, and 11,000 units in the United States, the average per capita consumption in India is only 200 units. As India strives to meet its ambitious plans a number of new developments are occurring which will affect the type of equipment required. Super thermal power stations of upto 3,500 MW are now being set up based on the configuration of multiple generating sets. These units are located near the coal pit-heads to minimize coal transportation costs. Gas turbines are being increasingly deployed to utilize the surplus natural gas. Efforts to conserve resources have led to the use of better and newer equipment like fluidized bed boilers for optimal use of the high ash content Indian coal. High voltage direct current transmission for economic

transmission of bulk power is being introduced in India and, simultaneously, developments have also taken place on futuristic projects like Magneto Hydro Dynamics (MHD.)

b) Imports

As India has developed a significant domestic manufacturing capability, the GOI does not normally permit direct imports of electric power equipment unless imports are financed under bilateral loans or multilateral aid from the World Bank or its affiliates. Though the Indian equipment scenario is dominated by the GOI-owned BHEL, its record of quality and dependability has been considerably marred as a result of a number of controversies that have risen out of the use of equipment supplied by BHEL to the various Indian State Electricity Boards. The Indian power sector faces considerable resource constraints arising mainly from the financial ill-health of the state electricity boards. While, to a certain degree, this financial malaise is due to reasons arising from high transmission losses, low plant load factor of generating sets, overstaffing, etc., a significant reason for it is the uneconomical and artificially low pricing structure that the boards have established for power supply. For example, the power supplied for rural electrification and the agricultural sectors is highly subsidized. Political interference in the operations of the state electricity boards has led to considerable overstaffing. All these factors have a bearing on their financial performance and contribute to their inability to generate resources for expansion and growth.

Thermal stations in India, with imported equipment, account for 50% of the total installed capacity. However, their share in total power generation was about 60% thus very clearly highlighting the comparative inefficiency of indigenously manufactured equipment. With the growing realization that for the attainment of Seventh and Eighth Plan targets it is imperative for the power plants to be operated at the optimal capacity ratings, it becomes very necessary for the country to supplement its domestic manufacture and technology with imports of quality equipment.

c) Customs Duty

While the import of Power Equipment is permitted, customs duty applied has been oriented to availability of indigenous equipment to discourage imports. For example, on specific items the leviable basic duty may be only 35% but an additional auxiliary duty of 45% and a further 'countervailing duty' of 15% on the combined duty may be applied. The range of duty varies widely between the basic duty of 35% to even 110% depending on the equipment imported.

Exceptions to the above include lower rates for captive power generation plant equipment (30%); power equipment (including gas turbine) of 50MW and below capacity required for specified power projects (35%) and equipment of higher capacity needed for other power projects (25%).

d) Foreign Exchange

The Department of Power is responsible for the release of foreign exchange for the import of equipment and spare parts required for the operation and maintenance of power stations in the country. It also assesses the need to engage foreign experts for power utilities, both in the public and private sector.

e) Foreign Suppliers

The major suppliers of electric power equipment to India during the past few years have been the Soviet Union, United Kingdom, West Germany and United States. Other key suppliers include Japan, France, Italy, Canada and Sweden. The Soviet Union holds a vantage position because of bilateral rupee payment agreements between India and the Soviet Union which helps to boost Soviet exports. Highly competitive bilateral grant and concessionary loans offered by the U.K., Japan, Federal

Republic of Germany, France, Italy and Sweden have been significant factors in boosting these countries' exports. Canada's continued ability to provide similar funding will be a major factor in determining Canadian companies' success in securing major project contracts in this sector.

Significantly, concerted U.S. sales efforts in this sector have lately yielded results as evidenced by the recent technology transfer agreement between General Electric of USA and BHEL for the manufacture of gas turbines for utilization of natural gas as fuel for generation of power. BHEL expects orders for gas turbines worth about U.S. Dollars 100 million in the near future which, otherwise, would have to be imported. This is the first time that 'hi-tech' power equipment technology is being transferred from the U.S. to India. The agreement covers gas turbines upto 30 MW size with provision to add large size units in future. These turbines will also be used in "combined cycle" plants which are more efficient compared to the conventional thermal sets.

Power generation, transmission and distribution equipment that offer best potential for sales in India include: complete thermal power station equipment of 200 MW capacity and above; steam condensing turbines of 200 MW and above; pulverizer mills; start-up oil firing equipment; high capacity ash handling systems, multitubular dust collectors and electrostatic precipitators; boiler feed pumps; selected safety and relief valves; reheat types boilers for thermal power generators compatible with 200 MW and above capacity turbines; high capacity oil and air circuit breakers and transformers; selected control instrumentation systems; and generation equipment to meet the captive power demand of large industrial plants. In addition, significant potential exists for sales of mini and micro hydraulic turbines. Services relating to energy efficiency applications, utilities management and high voltage transmission also represent good potential.

f) Multilateral Funding

World Bank

As of May 1989, World Bank participation in India's power sector development has been in the form of 28 loans (US$5,339 million) and 18 IDA credits (US$2,306 million) for a total of 46 projects. Of this, 15 generation, 4 transmission and 3 rural electrification projects have been completed. 12 generation (of which 3 are hydro), 2 transmission and 5 (which include a mix of generation, transmission and distribution) are currently under implementation.

Asian Development Bank

The Asian Development Bank (ADB) has also provided loans and technical assistance to the Indian electric power sector during the past few years. Loans have been approved for the North Madras Thermal Power Project (US$ 150.0 million), Unchahar Thermal Power Extension (US$ 160.0 million) and Rayalaseema Thermal Power Project (US$ 230.0 million).

The list of equipment normally required for ADB financed power projects includes equipment for power generation, transformers, transmission lines, power line carrier equipment, circuit breakers, capacitors, alternator sets, electric meters and penstocks.

During 1988 and 1989 several technical assistance projects were also funded by the ADB. These included an operational improvement support project for the Andhra Pradesh State Electricity Board and a National Program for Environment Management for Coal-Fired Power Generation.

Canadian firms interested in projects involving multi-lateral funding should contact the World Bank Liaison Officer at the Canadian Embassy in Washington D.C. or ADB Liaison Officer at the Canadian Embassy in Manila.

4. THE INSTITUTIONAL STRUCTURE

The institutional make-up of the energy sector in India reflects the size, constitutional landscape and historical evolution of the country. Electricity has been typically organised along state lines and therefore is akin to the provincial role in the Canadian electricity field. However, the growing power needs of the country, the urgency of the task and the heavy associated financing costs have combined to encourage a expanding role for the Central Government. This has assumed several forms, arguably one of the most visible being a number of agencies created with specific responsibilities for larger projects and for establishment of a national grid.

a) Ministry of Energy, Department of Power

The primary responsibility of the Department of Power pertains to the field of development of electrical energy. The Department is concerned with perspective planning, policy formulation, processing of projects for investment decision, project monitoring, training and manpower development and the enactment and administration of legislation in regard to power generation, transmission and distribution.

The Department of Power is headed by a Secretary who is assisted by an Additional Secretary and six Joint Secretaries including the Financial Adviser.

b) State Electricity Boards

State Electricity Boards (SEBs) were set up under the 1948 Electricity Act with the object of i) promoting efficiency and coordination in the generation, transmission and distribution of electricity and ii) regulating private electrical utilities and licensees. The result is that State governments in India — like the Provinces in Canada — own or control some 90 percent of electricity supply capacity. Their daily management is set to be conducted in an autonomous fashion but on larger issues such as capital spending, tariffs and financing, SEBs are controlled by the State governments themselves (again, similar in substantial part to the relations between Canada's Provinces and their respective electric utilities). 18 of 25 States have their own Electricity Boards.

Because of both the limited size of the economies of many of the States and inadequate tariffs, SEBs have often found themselves short of the kinds of financial resources needed to realize larger projects.

c) Regional Electricity Boards

As the individual State electricity grids have become increasingly interconnected, a requirement for inter-state coordination on matters relating to electricity supply has been perceived. Regional Electricity Boards were thus set up to coordinate the power system; individual Boards were established for the Northern, Southern, Eastern, Western, and North-Eastern areas of the country. These Boards coordinate the maintenance programmes in the States covered, determine and schedule the amount of power available for inter-state exchange and, as well, establish the price schedule for such exchanges.

d) Central Electricity Authority

The Central Electricity Authority (CEA) is a statutory organisation constituted under the Electricity (supply) Act, 1948. The CEA is a key authority on major power projects as it has responsibility for sanctioning the technical/economic viability of these projects. Further its input is received prior to the granting of import clearances. Other formal functions of the CEA include:

i) to formulate short-term and perspective plans for power development;
ii) to collect data concerning generation, distribution and utilisation of power, study of cost efficiency, losses, benefits, publication of reports and investigations;
iii) to advise the State Governments, Electricity Boards, Generation Companies or any other agency engaged in generation or supply of electricity on such matters as would improve the operation and maintenance of their systems in an efficient and coordinated manner;
iv) to promote and assist in the timely completion of schemes sanctioned in the Power Sector and to monitor the implementation of the schemes;
v) to make arrangements for advancing the skills of persons in the generation and supply of electricity;
vi) to promote research in matters affecting the generation, transmission and supply of electricity; and
vii) to advise the Central Government on any matter on which its advice is sought or make recommendations which would help in improving the generation, distribution & utilisation of electricity.

e) National Thermal Power Corporation

Along with the National Hydro Power Corporation, the National Thermal Power Corporation (NTPC) was begun by the Indian Government in 1975. Reporting to the Ministry of Energy, NTPC responsibility is the design/construction/operation of large thermal-based generating stations and related transmission systems. It sells this electricity to the State Electricity Boards who, in turn, make it available to users on their respective grids. As part of its transmission mandate, NTPC is the principal Central Government entity involved in the construction of an extensive 400 kv, extra high voltage power supply network.

The NTPC has currently an installed capacity of 8000 MW. It proposes to add another 10,000 MW in the next five years by way of nine coal-based and six gas-based thermal plants.

f) National Hydroelectric Power Corporation

Begun in 1975 along with the NTPC and with parallel responsibilities in hydro generation/transmission, the National Hydroelectric Power Corporation (NHPC) has not developed nearly as fast as its thermal counterpart. One main obstacle has been connected with water use rights. In India these come under the authority of States who, while often not individually strong enough to exploit the resources, have at the same time been reluctant to part with this aspect of their constitutional base.

Currently, NHPC has a considerable number of projects (including transmission projects) in progress and once realized, will make NHPC a much larger player in the Indian energy picture.

g) Rural Electrification Corporation

This Central Government corporation was set up in mid-1969 and reported initially to the Ministry of Irrigation and Power; more recently, it has come under the authority of the Ministry of Energy. The corporation is the financing vehicle for Central Government-funded rural electrification projects; it on-lends to the State Electricity Boards with the objective of realizing the latter's rural electrification schemes. The corporation is said to be responsible for over half of all rural electrification financing in India. Though the corporation's board is evidently composed of Central Government appointees, senior management has a significant proportion of secondees from the State Electricity Boards (at one stage, 40 percent).

h) National Projects Construction Corporation

The National Projects Construction Corporation (NPCC) is a joint venture of the Central and State

Governments. The Corporation was set up in 1957 to function as a contracting agency for the construction of civil and allied works of irrigation and power projects. Over the years, the Corporation has attained sufficient expertise in different fields of construction and is presently engaged in civil engineering works, such as irrigation, flood control and thermal and hydro power stations.

i) Central Water Commission

The Central Water Commission plays a key role in evaluating hydel projects. It reviews civil designs, costs, construction methods etc. and its approval is required for the sanctioning of large projects at the Public Investment Board level.

j) Central Power Research Institute, Bangalore

The Central Power Research Institute (CPRI) was established by the Government of India in 1960 to serve as a National Laboratory for applied research in electrical power engineering and also to function as an independent authority for testing and certification of electrical equipments manufactured in the country.

The CPRI provides testing and consultancy services to electricity supply utilities, manufacturing industries and other organizations for new product development and quality assurance.

k) Power Engineers Training Society

Power Engineers Training Society (PETS) was established by the Government of India in 1980 to function as a National Apex Body for meeting the training needs of the power sector.

l) Central Board of Irrigation & Power

The Central Board of Irrigation & Power (CBI&P) was constituted in 1927 with the main objectives of facilitating the dissemination of knowledge and rendering advice to the State Governments/State Electricity Boards on technical matters, especially in research.

m) Power Finance Corporation

The Power Finance Corporation (PFC) was incorporated on July 16, 1986 as a public limited company under the administrative control of the Department of Power. It has been set-up with the main objective of providing term-finance for power projects. PFC has concentrated on providing supplementary funds to the State Electricity Boards particularly for renovation, modernization programs. It has an authorised share capital of Rs.1,000 crores and a paid-up capital of Rs.330 crores. As of March 1989, it has sanctioned loans for 75 projects totalling about Rs.595 crores including for renovation and maintenance of thermal power plants, shunt capacitor installations and transmission and distribution systems.

5. ENERGY CONSERVATION

a) Overview

Energy conservation results in multiple benefits for the economy. It cuts down production costs and enhances productivity. It reduces the demand for additional production of energy and releases more and more energy investment for capacity creation and expansion in other productive sectors. More importantly, it provides a more economic means to overcoming energy shortages, and protecting the environment.

Energy efficiency has been a key component of global economic development over the past few decades. New technologies and innovations, besides the unprecendented attention paid to reducing production costs, have led to considerable amelioration of energy intensities in production. This process, no doubt, gained momentum from the oil price crisis. The recent decline in oil prices has not, however, reduced the pace.

The progress made in energy conservation the world over is amply clear from the trends in the GDP to energy use ratios. The average consumption of energy (in terms of kg of oil consumption per unit $ of GDP) has registered sharp decline since 1965.

Country	Average Energy Consumed (in kg of oil per unit $ of GDP)	
	1965	1987
India	1.06	0.75
Philippines	0.85	0.41
Thailand	0.57	0.37
Mexico	1.24	0.75
Brazil	1.25	0.39
U.K.	2.14	0.38
Australia	1.61	0.43
France	1.20	0.24
FRG	1.64	0.25
Canada	2.50	0.63
Japan	1.58	0.17
USA	1.83	0.39

(Data derived from World Development Report 1989)

b) India's Energy Conservation Program

The GOI clearly sees energy conservation as an indirect way of increasing power availability. For example, the GOI has conducted studies which show an energy conservation potential of 25% in the industrial sector, 20% in the transport sector and 30% in the agriculture sector. UNDP, EEC and World Bank are already assisting India in the energy conservation efforts including manpower training.

In spite of this, however, energy conservation in India to date, expressed in terms of reduction of national energy consumption per unit of GNP, has achieved only limited success when compared with the highly industrialized countries, especially Japan, Europe, the USA and Canada. This is due to a combination of features peculiar to India. At the macro-level, weaknesses in the policy environment affecting relative prices, pricing regimes, and incentives are no doubt major factors. However, at the micro-level, lack of trained man power in the field of energy management, inadequate data base for decision making, lack of energy conservation equipment, lack of experience with respect to design, development and implementation of large-scale energy conservation programmes, etc. are some of the major factors that need immediate attention. It is here that the impact of international cooperation is thought to be most beneficial. Cooperation from various international bodies is focussed on training, exchange of information, development of technical and policy standards, procurement of software/hardware etc.

Within the Department of Power an Energy Conservation Wing has been set up to act as the focal point to co-ordinate efforts to conserve energy. At this stage, the three main objectives which the GOI has set in this area are:

1. To bring attitudinal changes in all energy users, so that they strive for maximum energy efficiency.
2. To adopt policies which make energy conservation easy and attractive for being adopted by all energy users and to provide disincentives for inefficient users of energy.
3. To view Energy Conservation as a new source of energy and exploit it fully to bridge the gap between demand and supply of energy.

The GOI's program of energy conservation includes the setting of specific energy consumption targets, mainly in regard to energy intensive industries; energy audits; preparation of action plans; monitoring; demonstration projects; imparting of training in order to create a cadre of energy managers; standardisation of electrical equipment and appliances commonly used in the domestic and commercial sectors; efficient lighting systems and awareness campaigns on the need and scope of energy conservation.

State governments have also a major role to play. They are currently involved in stipulating standards for equipment manufacturers. State governments are also actively involved in a scheme for educating manufacturers and consumers of the advantages of supplying and utilizing energy efficient equipment.

In the agricultural sector a programme for rectification of pump sets has been initiated. State Electricity Boards are extending advisory services to agriculturalists to ensure that standard specifications are used for irrigation pump sets. The SEBs are also setting up Energy Conservation Cells to act as focal points for conserving energy.

c) Proposed Action Plan for Energy Conservation

Clearly, more attention is being placed on energy conservation by both the public and private sector. At the Third National Conference on Energy Conservation on March 27/28 organized by FICCI an action plan for Energy Conservation was proposed. Some of the more significant recommendations arising from the conference included:

1. The commitment of 10% of the Energy Sector outlay for energy conservation projects in the Eighth Plan.
2. The funding of specific energy conservation related Research and Development activities through the GOI and Energy Conservation Promotion Organizations. This would apply to R&D Institutions in both the public and private sectors.
3. An accelerated program to utilize the co-generation potential in the country.
4. A reduction in duty an imported equipment and devices necessary for energy conservation projects.
5. The requirement that all industrial units complete at least primary energy audits and undertake follow-up action by the end of the Eighth Plan.

d) Role for Canada

Canada has considerable expertise and experience in the area of energy conservation, particularly since the early 1970s. Canadian industry has developed energy-efficient technologies for industrial, commercial and transportation sectors. There is thus considerable potential for exchange of information, energy conservation and management services, and collaboration for development and manufacture of energy-efficient equipment in India.

In this context the recently concluded two-day seminar on energy conservation organized by the FICCI and attended by top industry and government representatives identified a number of areas for installation of energy saving technology and processes in such basic industries as steel, aluminum, copper, cement, paper, glass, caustic soda, soda-ash, electric arc furnaces, etc. The severe resource constraint

in the Eighth Five Year Plan was recognized as an impediment in augmenting power supply through additional projects and thus the importance of energy conservation applications is being stressed. The seminar in particularly highlighted the urgent need for efficient use of coal in thermal plants. In making its recommendations the seminar emphasised the role of consultancy services as well as import of energy saving equipment at concessional import duties. The seminar also identified reduction of the present 20% transmission losses by at least half in the Eight Plan period as well as reducing distribution losses. Canadian experience in public utilities management, time-of-day metering, peak-load management and retrofitting, renovation and modernization of equipment and other areas is well placed to assist in India's energy conservation program.

6. RENEWABLE/NON-CONVENTIONAL ENERGY

a) Renewable & Non-conventional Sources of Energy

In view of the continued demand pressure on conventional sources of energy and its limitation to serve growing energy needs, it is now generally accepted that renewable energy sources have to play a larger role. In recognition of the importance of renewable and non-conventional energy, the Department of Non-Conventional Energy Sources was set up in 1982.

Considerable R&D work has been continuing in the area of Renewable & Non-conventional Sources of Energy. The programmes currently under way envisaged an investment of Rs. 100 crores in 1988-89 of which a little more than half was allocated to the development of biogas equipment. Other areas of continuing research include solar thermal energy, solar photovoltaics, wind energy, improved wood burning stoves (chulhas), etc.

A significant degree of wide-ranging international cooperation has emerged in this field. For example, an agreement with USSR includes development of direct coal-fired cumbustors/gasifiers, fluidized bed-gasifiers for gasifying different quality coals and development of pulsed MHD generator. A major project under the agreement envisages retrofitting of one of the existing large thermal power plants with MHD power generator. An agreement with the US related to biomass production and conversion and coal conversion projects. A study on Co-gen systems in the U.S. and their integration into the main power systems is presently on. Under an agreement with USAID, funds are provided for R & D work in commercially attractive technologies for conversion of biomass and solar energy.

Under World Bank auspices, pre-investment/project preparation activities have been initiated in the areas of bagasse cogeneration systems, irrigation based mini-hydro systems, commercial scale windfarm development, solar water heating in industrial/commercial residential sectors and the dissemination of improved wood burning stoves. A follow-up action calls for the development of two or three wind farms of aggregate capacity upto 100 MW based on wind turbines of 200-300 KW unit size. A variety of R&D work is in progress in collaboration with France, Canada, Denmark, Netherlands and the EEC, which include such projects as solar thermal chilling plants and ice pack freezers, refrigeration system, etc.

b) Development of Micro, Mini and Small Hydro-Electric Projects

The development of micro, mini and small hydro-electric projects has been engaging the attention of the Department of Power in the context of supply of electricity to remote areas.

Micro, mini and small hydro-electric projects are at present being executed under the State plans. State Governments have been empowered to undertake the implementation of the schemes, the total cost of

which does not exceed Rs. 5 crores, without seeking the clearance of the Central Electricity Authority. In order to provide an impetus to the programme, a sum of Rs. 10 crores has been allocated in the Central Sector in the Seventh Plan for the development of micro, mini and small hydroelectric projects.

Presently 111 micro/mini/small hydro stations with an aggregate capacity of 201 MW are in operation in the country. 82 Schemes with an aggregate capacity of 218 MW are under various stages of construction.

In addition, the Department of Non-conventional Energy Sources (DNES) has plans to develop hydel projects of 3 MW capacity to generate a total of 2,000 MW through mini hydel projects. There are three demonstration projects set up by the Alternate Hydro Energy Centre: Jubbal (1 x 100 and 2 x 25 KW), Manali (2 x 100 KW) - both in Himachal Pradesh - and Kakroi (3 x 100 KW) in Haryana. Two of these projects have used imported synchronous alternators from Austria and USA. Other Mini/Micro hydel projects under constructions include those in Punjab, Madhya Pradesh and Orissa. The DNES is encouraging foreign collaboration in the manufacture of latest technology equipments for improved PLF through better microprocessor controlled operation.

Canadian companies have expertise not only within Canada but also in other countries in setting up small, mini and micro-scale projects and their packaged power turbines could be a significant source for marketing in India, considering the present emphasis in this area for power generation. Canadian companies willing to set up joint ventures with Indian firms in this area can obtain further details on the opportunity through the Canadian High Commission.

c) Tidal Power Generation

The Central Electricity Authority, with the help of other specialised agencies in the country and some consultancy support, had undertaken investigations and studies to assess the techno-economic feasibility of a Tidal Power Project in the Gulf of Kutch. The feasibility report has been prepared and it indicates that a 900 MW Tidal Power Project is feasible in the Gulf of Kutch and its cost would be comparable to that of the coal based or gas based thermal power stations in the country. Detailed studies for finalisation of designs and contract documents are now proposed to be carried out over the next 2 years before taking up the actual construction of the project.

d) Assessment of Geo-Thermal Energy Potential

A project for assessment of geo-thermal potential for generation of power is under implementation by the Central Electricity Authority in Puga Valley, Ladakh (Jammu & Kashmir). The initial drilling of an exploratory bore hole done by the Geological Survey of India had indicated a continuous increase in temperature and a maximum temperature of 127°C was recorded at a depth of 385 meters. Now the drilling of two fresh bore holes upto a depth of 550 meters has been entrusted to M/s Mineral Exploration Corporation Limited in order to explore the potential further . A revised cost estimate amounting to Rs. 329.5 lakhs has been sanctioned for the project. The work is likely to be completed in 1991-92.

e) Solar Thermal Power

India is one of the most active countries world-wide in the study, utilization and promotion of solar energy. As a result of intensive research and development and demonstration efforts of the Department of Non-Conventional Energy Sources several solar energy devices have been developed by R&D organizations. The focus of both the Department of Non-Conventional Energy and the Solar Energy Centre (established to help the GOI meet its objectives in solar energy) is on the following areas:

1) Testing and standardizing the solar energy equipment being produced in India.

2) Helping industries develop equipment to pilot plant scale.
3) Acting as a bridge between R&D organizations and production units.
4) Developing new materials needed for solar energy utilization.
5) Training manpower in different technologies.
6) Collaborating with international organizations in testing and standardization of solar devices.
7) Procuring technology from other countries.

Several Canadian firms employing various technologies have been active in pursuing opportunities in the Indian solar energy market. At least one collaboration has already been established and considerable potential exists for future cooperation given the priority being placed by India on the solar field. There is excellent potential for utilizing this form of energy in a variety of facilities in India including pulp and paper mills, hotels, hospitals, apartment buildings etc.

f) Solar Photovoltaics

The direct conversion of solar energy into electricity using photovoltaic systems is considered to have significant potential in India. This form of solar energy utilization is attractive in view of the favourable solar radiation conditions and large requirements for electrical energy for decentralized applications.

Canada's strength in photovoltaics lies in systems engineering and applications. The various components of a P.V. System including the modules, energy storage, power conditioning unit, auxilliary power source and load may be configured in a wide variety of ways. Knowing how to bring these components together in any given system application is critical. Canadian expertise in this area is most relevant as system engineering and application is a key requirement in India.

g) Biogas & Biomass

Under its Waste Recycling and Resource Recovery Systems (WRRRS), the Department of Non-Conventional Energy Sources has successfully set up biogas plants and power generation Plants utilising animal, human, municipal, agricultural and industrial wastes. During 1988-89 a sum of Rs. 57 crores was allocated for this purpose, representing 57% of total allocations for non-conventional energy development. In addition, a sum of Rs. 6 crores was allocated for R&D and Demonstration projects for conversion of biomass into energy through direct combustion, carbonization/pyrolysis, liquefaction and gasification.

Canadian expertise in bioenergy conversion technologies could be valuable for India for a variety of applications including steam and electricity generation, space and water heating, process heat, mobile and stationary engines, gas turbines and cooking.

h) Wind Energy

The wind energy programme of the GOI aims at harnessing wind energy potential for water pumping, battery charging and electricity generation. The potential is estimated as in excess of 20,000 MW for power generation alone. A multi-pronged strategy involving strengthening and expansion of wind data base, research, development, demonstration and indigenous production of wind electric generators has been formulated to provide thrust in this area. Some well-known Indian companies have already embarked upon the manufacture of wind electric generators. DANIDA is extending grants for pilot projects for development of wind electric generators, while the World Bank is assisting in Windfarm Development Studies.

Canadian expertise in wind turbine designs and its experience in Canada and elsewhere could be a source for collaboration and marketing in India.

i) Competitive Situation

The Indian industry is in its infancy with local production expected to be approximately US$ 200 million in 1990. Most of the technologies exploited commercially have been developed indigenously. This is apparent in solar thermal applications where only low temperature devices are being commercially manufactured; wind, where domestic technology is limited to the manufacture of wind pumps and SPVs, where the production is largely based on local technology. Indigenous technologies have not met the requirements for significant commercial success either due to high costs or inefficiencies.

Domestic manufacture of renewable energy equipment is limited to solar thermal devices including solar cookers, hot water systems, driers, wind pumps. There are over 100 manufactuers comprised largely of established companies which have diversified into renewable energy equipment. These firms continue to retain other lines as their mainstay. Some examples of solar photovoltaic manufacturing systems are those of Central Electronics Ltd., Bharat Heavy Electricals Ltd., and Rajasthan Electronics and Instruments Ltd., all public sector companies.

The nascent state of the domestic industry and the lack of adequate know-how in manufacturing specialized equipment, particularly for power generation from solar thermal and wind energy, provide considerable potential for direct sales to Indian end- users by foreign suppliers. There have been significant imports of wind turbines, specialized solar collectors, power generating equipment and raw materials such as silicon wagers, selective coatings and controls.

The value of imports in 1989 was estimated at US$26 million. Imports from Denmark constituted 32.5% of the total value of imports. This is followed by the U.S. and West Germany with 18% each. Brazil's share was 10%. Denmark's dominance is due mainly to its monopoly in the supply of wind powered electric generators and solar thermal controls. Selective coatings were imported from Canada and the U.S.; solar thermal power generation equipment was imported mainly from the U.S.; silicon wafers from West Germany and Brazil. Brazil has captured a major portion of the market for silicon wafers due to consistent quality and competitive pricing.

Dutch firms are making a concerted effort to enter the Indian market. Windpower Holland BV, a leading Dutch manufacturer of wind generators, is negotiating a turnkey project with the Uttar Pradesh Energy Development Agency for electrification and water pumping. Windpower Holland is also negotiating the sale of wind powered electric generators in the range of 25-80 KW with the Gujarat Energy Development Agency. Other Dutch firms seeking opportunities in wind energy in India are LMW and Sotrk and Polymarin BV.

Projections through 1990 indicate that Danish dominance will erode in favour of the U.S. and Japan. This is due to the relative decline in the importance of wind energy in comparison to solar photovoltaics.

Quality, price and soft payment options are the main factors which determine the choice of suppliers. India, like most developing countries, faces a continuing financial crunch. Easy payment schedules, soft loans and aid programs strongly influence the selection of suppliers. Imports of wind electric generators from Denmark were heavily influenced by a creative Danish financing package.

7. ENTERING THE INDIAN ELECTRIC POWER, ENERGY CONSERVATION AND RENEWABLE ENERGY MARKET

The Indian market is complex and difficult to enter. Despite the magnitude of India's foreign-sourced equipment and services, international firms require considerable effort and resources in order to become firmly established. Entry could be a time consuming process, often taking three years or more.

As the major purchasers in the Indian Power industry are government-owned agencies which are subject to scrutiny by the Indian Parliament, project/bid reviews are often extensive and protracted.

Generally, successful approaches by foreign companies can be characterised by the following features:

a) Accurate identification and selection of the most appropriate type of local representation.
b) A marketing strategy emphasizing flexibility and perseverance.
c) A marketing plan which focuses on the medium to long term as opposed to short term returns.
d) Highly competitive pricing of both end products, services, and technology transfers.
e) Provision of attractive concessional financing for transactions not covered by multi-lateral funding.
f) Collaboration in a variety of ways with Indian partners in the long term to realize the benefits accorded to local companies.

Local Representation

The single most important element in developing a successful approach to the Indian market is the proper local representation. Depending on the product, service or project, there are a number of suitable options. The choice may include a local agent working on a commission basis, a local representative as an employee of the foreign company, an Indian company as a licensing recipient, an Indian company as a joint venture partner with or without Canadian equity participation, etc. A combination, or series of these options over a period of time, is often the best way to maximise the contribution of local representation towards meeting a foreign firm's marketing goals. There are a number of reasons for according a pivotal role to local Indian representation. For example, Indian representation is important to ensure early market intelligence and appropriate follow up activities. A good representative knows months ahead of time that a tender of interest to a foreign principal would be called. An effective agent should be able to track developments of interest from the early planning stages right through the evolution of relevant government policies to the stage of drawing up tender specifications. Further he should be able to obtain tender documents with sufficient lead time which is important to ensure that a foreign firm is positioned as advantageously as possible. An astute representative can also contribute to planning appropriate market strategies as well as determining the nature of the competition. He could also advise when appropriate intervention is called for at the Principal's level to clinch a business deal. Further an ability to effectively track down the progress of tenders and projects within the intensely bureaucratic system of India is extremely important.

Not unlike other Asian countries, India's business environment requires a great deal of direct personal contact. Numerous meetings at all levels, high ranking contacts and longstanding relationships are essential to developing, in Indian Power Sector officials, the confidence and enthusiasm required to support a foreign firm's business interests particularly as it relates to significant projects. The lead time and cost that a foreign company may require to develop this network of contacts and relation-

ships could well be exorbitant. A collaboration or a link up with a prominent Indian company, either as a partner or in an agency role can be extremely important for a Canadian firm to make and maintain the necessary contact with key Indian decision makers.

A well-informed Indian representative should also be familiar with the Canadian principal's business particularly as it relates to the firms product and service capability. The Government of India has set a priority on the indigenisation of Power Sector equipment and services. Increasingly, a foreign company's strategy for India will need to include local representation in some form of partnership. This is particularly important because a system of price preferences exists to support Indian suppliers of Power Sector equipment and services. In the equipment area, domestic producers are eligible for preferences ranging from 15% to 35%, depending on the degree of domestic content. Indian companies offering services are eligible for preferences ranging from 10% to 40%.

The Indian manufacturing industry, assisted significantly by the Confederation of Engineering Industry—its representative association, is developing a sound working relationship with the state-owned electric power industry. The growing confidence of the Indian private sector, coupled with the increased awareness and determination of the Indian Government policy makers, will cause the emphasis on indigenisation to accelerate in the coming years. Foreign firms then will increasingly be required to link up with India's manufacturing and servicing capabilities if they are to successfully enter the Indian market for equipment and services in the electric power, energy conservation and renewable energy markets.

Choosing an Indian Representative—Priority Decision

The selection of an Indian representative/partner requires a significant commitment of resources. While an agency relationship is appropriate for an initial entry into the market, the development of a more long term association is required if success is to be ensured over a medium to long term time frame. The time required for both the Canadian and Indian parties to assess their mutual capabilities can be lengthy. However, it is in the building of this knowledge, confidence and most importantly, mutual trust, that the success of a collaboration is likely to be ensured.

The local Indian representative regardless of his particular role, be it agent or full partner, should normally be a fully trusted and integrated member of a Canadian firm's team. Time invested in the selection process usually pays dividends in the form of open and high quality communications that yield well coordinated marketing strategies and optimal results.

The Canadian High Commission in New Delhi and Consulate of Canada in Bombay maintain an extensive roster of potential Indian representatives and collaborators. Through assistance from the Canadian commercial staff, Canadian firms seeking tie-ups have an excellent opportunity to meet with pre-screened potential Indian partners.

8. KEY CONTACTS IN CANADA AND INDIA

Canada

1. **The Department of External Affairs**, Government of Canada manages a programme of Trade Development activities in support of Canadian companies interested in exporting to India. The program includes missions, technical seminars, trade fairs, incoming buyers and market studies.

   The Deputy Director, Asia Pacific South Trade Development Division, Department of External Affairs, 125 Sussex Drive, Ottawa, Ontario, K1A 0G2, Telephone: 613-995-7689, Telex: 053-3745.

2. **The Canadian High Commission, New Delhi and the Canadian Consulate in Bombay** are in touch with the Indian power sector on a daily basis. They can provide information on Indian market conditions, Indian companies, government regulations, reputable agents, and a range of other commercial information pertinent to doing business in India.

   First Secretary (Commercial), Canadian High Commission, P.O.Box 5208, Shantipath, Chanakyapuri, New Delhi 110021, India, Telephone: 608161 Telex: 031-72362 DMCN IN Fax: 608161 Ext. 401. **or**
   First Secretary and Trade Commissioner, Consulate of Canada, Hotel Oberoi Towers, Suite 2401 Nariman Point, Bombay 400 021 Telephone: 202-4343 Extn. 2401, Telex: 011-4153 OBBY IN, Fax: 2043282.

3. **Industry, Science and Technology Canada** cooperates closely with External Affairs to develop and manage programs in support of Canadian exporters of energy equipment and services

   Energy Equipment Division, Department of Regional Industrial Expansion, 235 Queen Street, Ottawa, Ontario K1A 00H5, Telephone: 613-954-3192.

4. **The Canadian International Development Agency (CIDA)** administers Canada's official international development assistance program which includes more than 1000 programs in over 100 countries, and supports more than 400 non-governmental organisations in over 120 countries.

   Country Program Director, India/Nepal Program, Asia Branch, Canadian International Development Agency, 200 Promenade du Portage Hull, Quebec K1A 0G4, Telephone: 613-997-4747, Telex: 053-4140.

5. **The Export Development Corporation** is a Canadian crown corporation, wholly owned by the Government of Canada, that provides financial services to Canadian exporters and their foreign buyers to facilitate and develop Canada's export trade.

   Manager, South Asia Department, Export Development Corporation, 151 O'Connor Street, P.O.Box 655, Ottawa, Ontario K1P 5T9, Telephone: 613-598-2500, Telex: 053-4136.

6. **The Canadian Manufacturers Association** has established a close partnership with India's Confederation of Engineering Industry, which represents the Indian private sector. The CMA has organised a series of missions to India and is well informed about the climate for doing business.

   Manager, Export Development, The Canadian Manufacturers Association, 1 Yonge Street, Toronto, Ontario M5E 1J9, Telephone: 416-363-7261, Telex: 065-24693.

India

7. **The Confederation of Engineering Industry (CEI)** represents the Indian manufacturing industry and maintains a strong link with Indian policy makers in a wide spectrum of government departments. CEI have a partnership relationship with the Canadian Manufacturers Association and through their Energy Division can offer assistance with identifying Indian companies which are interested in foreign technology and expertise.

8. Director, Energy Division, Confederation of Engineering Industry, 23-26 Institutional Area, Lodi Road, New Delhi 110003, India, Telephone: 615115, Telex: 031-66655 AIEI IN.

9. Secretary, Department of Power, Ministry of Energy, Shastri Bhavan, New Delhi 110001, Telephone: 382966.

10. Secretary, Department of Non-Conventional Energy Sources, Ministry of Energy, Block 14, C.G.O. Complex, Lodi Road, New Delhi 110003, Telephone: 361481.

11. Advisor, Solar Energy Centre, Ministry of Energy, Block 14, C.G.O. Complex, Lodi Road, New Delhi 110003, Telephone: 361823.

12. Secretary, Ministry of Water Resources, Shram Shakti Bhavan, New Delhi 110001, Telephone: 3713098.

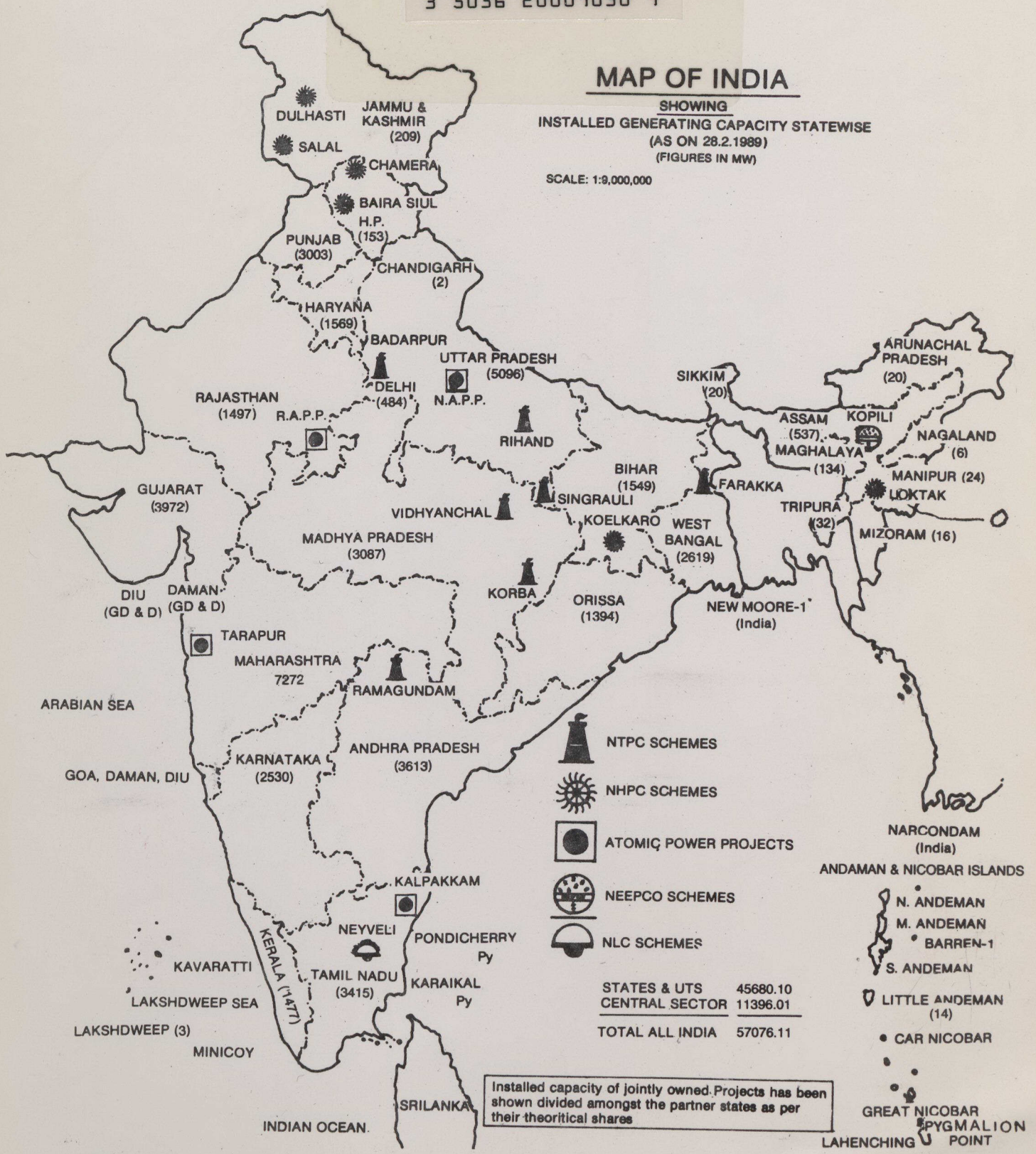
13. Chairman & Managing Director, Central Electricity Authority, Sewa Bhavan, R.K. Puram, New Delhi 110066, Telephone: 609212.

14. Chairman & Managing Director, National Thermal Power Corporation, Corporate Centre, NTPC Bhawan, SCOPE Complex, Lodi Road, New Delhi 110003, Telephone: 360044.

15. Chairman & Managing Director, National Hydro Electric Corporation, Hemkunt Towers, 98 Nehru Place, New Delhi 110019, Telephone: 6431408.

16. Chairman & Managing Director, Rural Electrification Corporation, DDA Building, Nehru Place, New Delhi 110019.

17. Chairman & Managing Director, National Projects Construction Corporation, 30 Nehru Place, New Delhi 110019, Telephone: 6416580/6412842.
18. Secretary, Department of Public Enterprises, Udyog Bhavan, New Delhi 110011, Telephone: 3012433.
19. Secretary, Ministry of Petroleum & Natural Gas, Shastri Bhavan, New Delhi 110001, Telephone: 383501.
20. Chairman & Managing Director, Bharat Heavy Electricals Limited, BHEL House, Asian Games Village, Siri Fort Road, New Delhi 110049, Telephone: 6442031.
21. Chairman & Managing Director, National Power Transmission Corporation (under set-up).
22. Power Finance Corporation Ltd., Chandralok, 36 Janpath, New Delhi 110001. Telephone: 3315824.
23. Andhra Pradesh State Electricity Board, Vidyut Soudha, Hyderabad 500049.
24. Assam State Electricity Board, Narangi, Gauhati 781026.
25. Bihar State Electricity Board, Vidyut Bhawan, Bailey Road, Patna 800001.
26. Gujarat Electricity Board, Vidyut Bhawan, Race Course, Vadodara 390007.
27. Haryana State Electricity Board, Shakti Bhawan, Sector-6, Panchkula 134109 (Haryana).
28. H.P. State Electricity Board, Kennedy Cottage, Shimla 171004.
29. Karnataka Electricity Board, Cauvery Bhawqn, P.B. No. 5342, Bangalore 560009.
30. Kerala State Electricity Board, Vidyuthi Bhavanam, Pattom, Pattom Palace P.O., Trivandrum 695004.
31. M.P. Electricity Board, P.B. No. 34, Rampur, Jabalpur 482008.
32. Maharashtra State Electricity Board, Hong Kong Bank Building, M.G. Road, Fort, Bombay 400001.
33. Meghalaya State Electricity Board, Shillong 793001.
34. Orissa State Electricity Board, Bhubaneswar 751007.
35. Punjab State Electricity Board, The Mall, Patiala 147001.
36. Rajasthan State Electricity Board, Vidyut Bhawan, Vidyut Marg, Jaipur 302005.
37. Tamil Nadu Electricity Board, Electricity Avenue, 791, Anna Salai, Madras 600002.
38. West Bengal State Electricity Board, Vidyut Bhawan, DJ Block, Sec. II, Salt Lake City, Calcutta 700091.
39. U.P. State Electricity Board, Shakti Bhawan, 14, Ashok Marg, Lucknow 226001.
40. Calcutta Electric Supply Company Ltd., Chowringhee Square, Calcutta 700001. Telephone: 276000.
41. Damodar Valley Corporation, Bhavani Bhavan, Alipore, Calcutta 700027. Telephone: 453823.
42. Central Power Research Institute, Post Box 1242, Bangalore 560012.
43. Power Engineers Training Society, 207 Chiranjiv Towers, 43 Nehru Place, New Delhi 110019. Telephone: 6418227.
44. National Productivity Council, Fuel Efficiency Division, Institutional Area, Lodi Road, New Delhi 110003. Telephone: 690331.
45. Indian Electrical & Electronics Manufacturer's Association, 501 Kakad Chambers, 132 Dr. Annie Besant Road, Worli, Bombay 400018.



The territorial waters of India extend into the sea to a distance of twelve natuical miles measured from the appropriate base line. The boundary of Meghalaya shown in this map is as interpreted from the North Eastern Areas (Reorganisation) Act 1971 but has yet to be verified. The responsibility for the corrections of internal details rests with the publisher. The administrative Head-Quarters of Chandigarh, Haryana & Punjab are at Chandigarh. Based upon Survey of India map with the permission of the Surveyor General of India.

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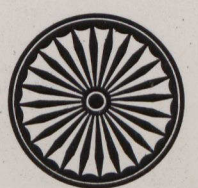

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