Industry Canada Industrie Canada

SECTOR COMPETITIVENESS FRAMEWORKS

ELECTRIC POWER EQUIPMENT AND SERVICES

PART 1 – OVERVIEW AND PROSPECTS

Industry Sector
Manufacturing and Processing Technologies

Secteur de l'industrie
Technologies de fabrication et de transformation

Canada

Electric Power Equipment and Services

Part 1 – Overview and Prospects

Prepared by:

Manufacturing and Processing Technologies Branch

This *Overview and Prospects* is the first of two companion documents on Canadian electric power equipment and services industries in the **Sector Competitiveness Frameworks** series, which is being produced by Industry Canada in collaboration with Canada's key stakeholders in the industry. *Part 2 — Framework for Action* will be prepared in coming months, based on discussions with major industry stakeholders, following study and review of the *Overview and Prospects*.

The **Sector Competitiveness Frameworks** series focusses on opportunities, both domestic and international, as well as on challenges facing each sector. The objective is to seek ways in which government and private industry together can strengthen Canada's competitiveness and, in doing so, generate jobs and growth.

Part 1 — Overview and Prospects is being made available for distribution in printed as well as electronic forms. In all, some 30 industrial sectors are being analyzed.

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FOREWORD

The new Canadian marketplace is expanding from national to global horizons and its economic base is shifting increasingly from resources to knowledge. These trends are causing Canadian industries to readjust their business approaches, and government must respond with new tools to help them adapt and innovate. Industry Canada is moving forward with strategic information products and services in support of this industry reorientation. The goal is to aid the private sector in what it is best qualified to do — create jobs and growth.

Sector Competitiveness Frameworks are a series of studies published by Industry Canada to provide more focussed, timely and relevant expertise about businesses and industries. They identify sectors or subsectors having potential for increased exports and other opportunities leading to jobs and growth. They cover 30 of Canada's key manufacturing and service sectors.

While they deal with "nuts and bolts" issues affecting individual sectors, the Sector Competitiveness Frameworks also provide comprehensive analyses of policy issues cutting across all sectors. These issues include investment and financing, trade and export strategies, technological innovation and adaption, human resources, the environment and sustainable development. A thorough understanding of how to capitalize on these issues is essential for a dynamic, job-creating economy.

Both government and the private sector must develop and perfect the ability to address competitive challenges and respond to opportunities. The Sector Competitiveness Frameworks illustrate how government and industry can commit to mutually beneficial goals and actions.

The Sector Competitiveness Frameworks are being published sequentially in two parts. An initial *Overview and Prospects* document profiles each sector in turn, examining trends and prospects. The follow-up *Framework for Action* draws upon consultations and input arising from industry–government collaboration, and identifies immediate to medium-term steps that both can take to improve sectoral competitiveness.

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1 HIGHLIGHTS

Vast quantities of falling water and a plentiful supply of coal and uranium have helped Canada become the sixth largest generator of electric power in the world, the world's largest producer of hydro-electric power and among the top two or three largest per capita consumers and exporters of electricity. The immense energy requirements of large resource industries, along with the challenge of equipping long-distance transmission systems to serve a vast country and withstand severe climatic conditions, have developed the capabilities of manufacturers, consulting engineers, constructors and utility operators. Their technical know-how has also helped build electric power projects in over 70 countries around the world.

1.1 The Electric Power Equipment and Services Sector

This *Overview and Prospects* document, which has been prepared in close cooperation with the National Electricity Roundtable (see below, p. 15), addresses the Canadian electric power equipment and services sector. The sector has come into existence to meet the needs of the electric power industry. The manufacture of electric power equipment is carried on by more than 200 establishments, with approximately 85 percent of the activity located in Ontario and Quebec. The power industry is also served by 197 consulting engineering firms and engineering contractors.

In 1995, the manufacturers contributed 1 percent of manufacturing gross domestic product (GDP) and $1.7 billion (measured in current dollars) in value-added to the Canadian economy. They accounted for $3.2 billion in shipments, of which $1.5 billion was exported. Equipment imports amounted to $2.3 billion. In real terms, value-added for the manufacturers grew by 22 percent from 1988 to 1995. The sector as a whole, including consultancy and management services, in 1995 provided high-paying jobs for approximately 25 000 employees; of these, about 17 400 were in electric power equipment manufacture and some 8 000 were in related services.

The equipment manufacturers and consulting engineers (who include engineering contractors) form part of the electric power industry, together with their customers, the utilities and independent power producers that perform the primary functions of generation, transmission and distribution of electricity. The industry employs more than 113 000 people and contributes just under 5 percent of GDP. The 16 major power utilities across Canada account for 88 000 of these jobs.

1.2 Distinguishing Characteristics

Ownership

With one or two exceptions, the consulting engineering firms in the sector are Canadian owned, but large multinationals based in Europe and the United States own almost all the big electric power equipment manufacturers in Canada. This is both an enabling and a constraining factor. The Canadian subsidiary can take advantage of the contacts, sales force, access to capital and state-of-the-art technology of its parent, but is confined to activities determined by the parent and may not be permitted to pursue all the business opportunities to which it is suited.

Mandates

The influence and role of Canadian subsidiaries within their respective multinational corporations are crucial to the development of the sector. Strategies for investment retention centre on winning and defending product mandates. Leading Canadian manufacturers have enjoyed considerable success in this respect, although this has not always preserved them from rationalization imposed from abroad.

Principal Market

Investment spending undertaken by producers of electric power has been the driving force shaping the sector and today constitutes its principal market. The sizable procurements of the 16 major utilities have created a substantial electric power infrastructure. This infrastructure is characterized by a high capital/labour ratio, considerable design content, integrated project planning and management, and a continuing requirement for equipment, servicing and rehabilitation.

Trade

Exports of electric power equipment increased by 102 percent in real terms between 1988 and 1995 and represented 46 percent of total 1995 shipments. The top export destinations of electric power equipment by rank are the United States, the Republic of Korea, the United Kingdom, Thailand, Venezuela, Taiwan and China. Exports to the United States accounted for 79 percent of total sector exports in 1995. Exports to Asia have also been growing strongly in contrast to exports to Europe, which have been declining. Canada is, however, a net importer of electric power equipment. Imports have increased in recent years, the bulk of this increase being imports from the U.S. The rapid growth of both exports and imports reflects the international specialization of the equipment industry.

In addition to the equipment suppliers, the major consulting engineering firms and some niche players are active in international markets for electric power services.

Technology

Technological progress in the sector recently has been consistent but undramatic. The provincial utilities take the leading role in research and development (R&D), working closely with equipment suppliers. Most of the sector's R&D is directed to such purposes as enhancing efficiency and adapting foreign designs to meet Canadian standards and climatic requirements. Prospects for the flow of new technology have dimmed recently as utility R&D budgets have declined, government funding has been subject to fiscal constraints and little basic R&D has been undertaken. Emerging (mostly renewable) energy technologies such as solar, wind, biomass, fuel cells and photovoltaics provide electricity without contributing to the carbon dioxide emissions associated with fossil fuels. In the near future, these technologies are projected to play increasing roles, particularly in niche markets.

1.3 Major Trends

Flattening of Domestic Power Demand

According to 1995 figures compiled by Natural Resources Canada, electricity demand is expected to grow at an average of 1.4 percent a year between 1995 and 2010. This forecast is largely based on estimates of economic and population growth in the next 15 years. This contrasts with annual average growth in electricity consumption, which was 6.6 percent from 1960 until the 1973–74 oil crisis and 3.2 percent for the period 1975–95. Since demand for equipment and services to a considerable extent is derived from demand for electricity, a similar flattening is anticipated in the sector's domestic business, at least in comparison with the situation in the early 1990s. What has particularly caused the sector to rethink its strategy has been the expectation that no new mega-projects comparable with the James Bay power development in Quebec will be required in Canada in the foreseeable future.

Rationalization of the Sector

After decades of rapid growth, equipment producers have been forced to concentrate on their most profitable products, shed unused capacity, and reduce prices and the range of products manufactured. The rationalization and consolidation of firms in the sector is part of a worldwide phenomenon, which has included a series of mega-mergers, and has been furthered in Canada by the lowering of North American trade barriers and the flattening of demand for new facilities for power generation. There are indications that this phenomenon may not entirely have run its course.

Emphasis on Exports

Anticipating a moderation in domestic demand and confronted by a potential surplus of plant capacity, the Canadian equipment and service providers have been concentrating their efforts on export markets. Demand for electric power in developing countries is increasing at more than 10 percent a year. There are many competitive strengths among sector participants, particularly the consulting engineers, who enjoy an outstanding record of success in export markets. Canadian companies do, however, face tough competition and market access barriers.

Increasing Importance of Financing

Host governments in developing countries are expanding the purview of private power, passing the risks that they formerly assumed themselves to developers and equipment suppliers. In addition to providing the best technology at the best price, suppliers now must also bring financing to the table and be prepared to bear a significant portion of the project risk. In fact, financing has become a prerequisite to even being considered for participation in international consortia and is arguably the most critical determinant of export success. Canadian suppliers must be able to tap the resources of international financial institutions, the Export Development Corporation, and private banks and investment funds in order to offer longer-term financing at higher risk in their bid packages.

Restructuring of the Utilities

The electric power industry is undergoing a global transformation that even extends to emerging markets. Canadian utilities, traditionally the sector's primary market, are moving from a comparatively low-risk environment in which they have enjoyed the advantage of a fairly predictable future to an environment of competition at wholesale and probably retail levels in which they will experience much greater cost pressures and much shorter planning horizons. The utilities' functions of generation, transmission, distribution and retail will probably be "unbundled" and they may well be divided into several distinct businesses. The strategies of their successor companies will emphasize staying lean and highly reactive to be able to respond to the needs of the electricity consumer.

As electricity becomes more and more like any other commodity, producers and marketers can be expected to differentiate and add value to their products by exploiting new transmission and distribution technologies. They will compete for customers with such products as energy audits, technology assessments, and troubleshooting and consulting services.

The business of the equipment and service suppliers will no longer be built on long-standing relationships with customers that permitted joint planning and the design of customized products, but on price, short lead times, flexibility of product offerings, standardized products, performance guarantees and strong support services. The sector

will also be impacted by the strategic alliances, partnerships, and mergers and acquisitions being undertaken by the electric power industry in an effort to exploit synergies and minimize risks. Convergence between electricity companies and gas companies is already happening and may be extended to include other industries in related areas. The future of the electric power equipment and services sector in Canada may well depend on making the most strategic links with the companies that will emerge from the current process of restructuring to engage in the production and marketing of electricity and other energy services.

1.4 The Bottom Line

The sector's prospects should be assessed in both short- and long-run perspectives. In the short run, the export market offers an opportunity to apply the experience and expertise that has been garnered in the mainstream technologies of generating, transmitting and distributing electricity. If the sector can mobilize its resources effectively, it can sustain its already reduced capacity and work force for a decade or longer. A vibrant export market should not, however, be allowed to postpone adjustment to the restructuring of the electric power industry. A deeper understanding of what markets are demanding, flexibility to cope with rapidly changing short-run requirements and a determined effort to seize the possibilities of a confusing array of new technologies will be required.

It will be impossible to survive in the energy business of the next century unless the participants share in an expansive vision of its purpose and work with government and other stakeholders toward making that vision a reality. The vision should highlight the role of electricity in satisfying customer wants and achieving sustainable development and global prosperity. Practical measures that position the sector to help realize these goals will constitute a *Framework for Action*. This present document seeks to assist the development of the *Framework* by providing a frank appreciation of the sector's current circumstances and prospects.

2 KEY POINTS ABOUT THIS INDUSTRY

2.1 The Sector and the Electric Power Industry

Canada's electric power industry is organized around 16 major utilities, of which seven are provincially owned, five are investor owned, two are municipally owned and two are territorial Crown corporations. The industry's main activities are the generation of electricity, its transmission at high voltages over long distances, and its distribution at lower voltages to industrial, commercial and residential customers. In 1995, the utilities accounted for approximately 94 percent of the country's total generating capacity of 115 505 megawatts. In addition, about 60 industrial establishments generate electricity for their own use and, in some cases, sell power to municipal distribution systems or utilities. There are many smaller utilities, most of which distribute electricity to customers and are owned by municipalities, and some of which have their own generating capacity. There is also a group of independent power producers (IPPs) that generate electricity for sale to the major utilities.

16 utilities produce 94% of Canada's electric power

Canada is among the six largest generators of electric power in the world, the world's largest producer of hydro-electric power, one of the largest exporters of electricity and among the top two or three per capita consumers of electricity. Approximately 88 000 people were employed in the generation, transmission and distribution of power in 1995, bringing in total revenue of $27.6 billion and contributing 3.6 percent of Canada's gross domestic product (GDP). In the same year, Hydro-Québec, Ontario Hydro and BC Hydro ranked second, third and thirteenth, respectively, in terms of assets among all Canadian companies.

Canada is largest producer of hydro power, one of largest exporters, and one of top per capita consumers of electricity

The utilities are highly capital-intensive. Their average capital-output ratio was 8.3 between 1961 and 1994. This ratio is very high, compared with 1.1 for all manufacturing industries and 1.6 for the economy as a whole over this period.

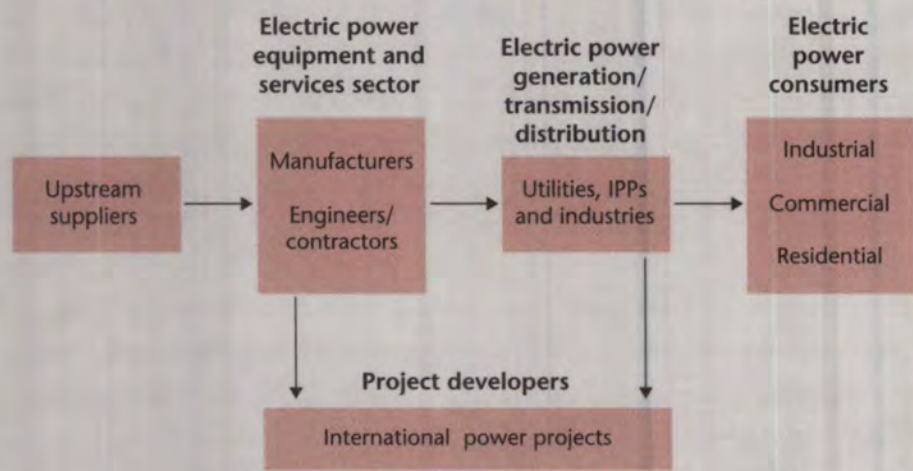
For purposes of this *Sector Competitiveness Framework*, the electric power equipment and services sector encompasses the manufacturers and consulting engineers who supply equipment and services for the generation, transmission and distribution of electric power by utilities and other power producers. The sector includes services related to the production, installation, overhaul and maintenance of power equipment and related consulting engineering services performed by private firms and the consulting operations of the utilities, but excludes the construction of power plants and dams. Also excluded is equipment used for industrial purposes, such as boilers used in industrial processes and smaller electrical transformers or switches used within an industrial plant. The equipment and services sector employs 25 000 workers.

Electric power equipment and services employ 25 000 workers

Electric power utilities shape, but are not part of, equipment and services sector

The growth and expansion of the electric power equipment and services sector have been moulded by the performance of the major utilities making up the backbone of the electric power industry (Table 1). The utilities have been the predominant customers of most of the major manufacturers and important customers of a range of smaller suppliers and engineering and contracting firms. The utilities' R&D, planning and design activities have been the source of the specifications to which the manufacturers have worked. The utilities' investment decisions have likewise had a direct impact on the output of their suppliers and thereby have governed the manufacturers' own investment decisions.

Figure 1. The Electric Power Industry in Canada



Sector players often partner with utilities in export strategies

The relationships among the players when they are trying to break into export markets differ from those that apply to the domestic market. Manufacturers and engineering contractors assume more central roles, joined by new players such as project developers and integrators, but the utilities may well become increasingly important to the export strategies of the sector. As sources of management expertise and investment capital, the utilities are in a position to partner with the manufacturers in bidding for projects abroad.

Sector's future is tightly bound with world markets for energy, including electricity

The future of the electric power equipment and services sector is tightly bound up with the way electricity markets, indeed markets for energy services, are evolving. The problems and prospects confronting the sector cannot be fully understood in isolation from those facing the electric power industry as a whole.

2.2 Snapshot of the Sector

Electric Power Equipment Manufacturers

Power Generation

Leaders among the manufacturers of power generation equipment are General Electric Canada Inc. (GE), GEC Alsthom Energies Inc., Rolls Royce Industries Canada Inc. and Westinghouse Canada (recently acquired by Siemens), which design and manufacture gas, steam and hydro turbines and electric generators. Babcock & Wilcox (B&W) is Canada's leading manufacturer of power boilers. These manufacturers subcontract a great deal of work to small and medium-sized enterprises (SMEs). Other small firms including Innovative Steam Technologies, Howden, Canadian Hydro Components and Mechron manufacture specialty and niche products such as turbines of various sizes for small and medium hydro applications, fans and secondary heat exchangers. Companies such as Ballard Power Systems, which has gained a leading role in fuel cell technology, and Electrolyser, which has successfully entered international markets for hydrogen-making equipment, specialize in emerging technologies. There are also a handful of specialized service and repair providers as well as three large international firms, Asea Brown Boveri (ABB), Siemens and Sulzer, that do not manufacture power generating equipment in Canada but offer technology solutions and project management, exploiting the advantage of their expertise and their ability to source the product through subcontracting or through purchases from associated companies.

Much generation equipment manufacture is subcontracted to SMEs

Atomic Energy of Canada Limited (AECL) and its major product, the CANDU reactor, spearhead the activities of companies that provide equipment and services for nuclear power, many of which are also active in the non-nuclear area. AECL markets and manages the construction of CANDU power plants, advances the knowledge and technology that underlie the CANDU and supplies R&D and engineering services to operating CANDU plants. Major subcontractors and equipment suppliers that are likely to benefit from a CANDU sale include B&W (nuclear steam generators), GEC Alsthom (calandria), Sulzer Bingham (nuclear pumps), Zircatec (fuel bundles and fuel channel tubes), GE Canada (fuel bundles and fuel loading systems) and CAE Electronics Ltd. (training simulators). A number of smaller companies supply forgings, valves, filters, instrumentation and controls, among other items.

Large and small subcontractors benefit from nuclear plant sales

Transmission and Distribution

A large number of firms manufacture the transformers, switchgear, and wire and cable required for the transmission and distribution of electric power from the point of generation to the point of sale, usually the customer's meter. There are five major producers of transformers: ABB Canada Inc., Ferranti-Packard Transformers Ltd., Moloney Electric, Pauwels Canada Inc.

Other subsectors present less opportunity for SME subcontracting

and Carte International Inc. ABB, GE, Siemens Electric Ltd. and Elsag Bailey Canada Inc. are active in the switchgear subsector, producing controls, circuit breakers, panels and switches. CAE Electronics Ltd., which makes control systems and simulators, is a leader in this field. There are about a dozen plants making bare and insulated conductors. There is less scope for subcontracting and SME participation in these subsectors than in power generation.

See Annex A for detailed descriptions of some of the larger companies by subsector.

Statistics

Statistics must be netted out from several SICs to compile sector profile

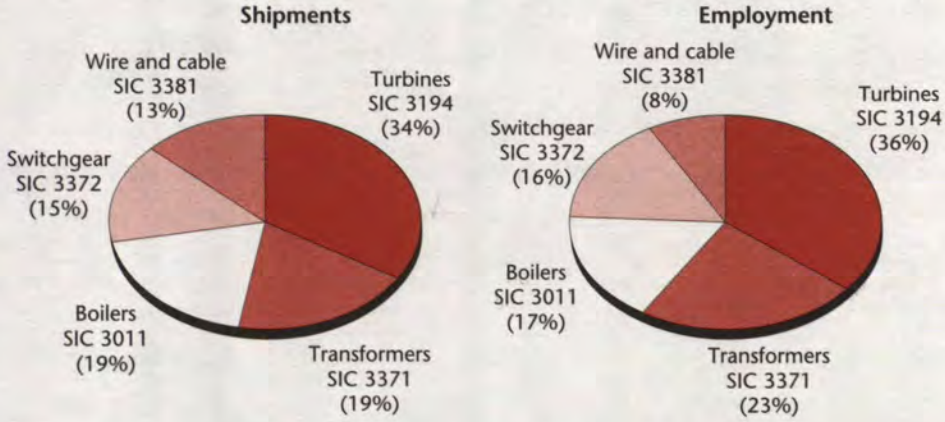
Statistics for the manufacture of electric power equipment have been developed by aggregating subsets of five Standard Industrial Classifications (SICs) defined by Statistics Canada, namely the power boiler and heat exchanger subsector (SIC 3011), the turbine and mechanical power transmission subsector (SIC 3194), the electrical transformer subsector (SIC 3371), the electrical switchgear and protective equipment subsector (SIC 3372), and the communications and energy wire and cable subsector (SIC 3381). The data construction method used in preparing this *Sector Competitiveness Framework* involves detailed consultations with industry representatives to arrive at an estimate of the share of each subsector that is directly related to electric power to net out the non-power components of the SIC statistics collected. Therefore, the data presented in this document represent only the electric power equipment component of the SIC data. The results indicate that 60 percent of SIC 3011 is related to electric power, 80 percent of SIC 3194, 85 percent of SIC 3371, 40 percent of SIC 3372, and 20 percent of SIC 3381.

220 establishments employ 17 382 workers, produce shipments worth $3.2B in 1995

The electric power equipment sector is highly concentrated, with a small number of firms accounting for much of the activity and employment. In 1995, there were 220 establishments, employing 17 382 people, with shipments valued at $3.2 billion. Value-added for the same year was $1.7 billion, with an associated value-added per employee of $95 000.

The turbine and mechanical power transmission equipment subsector represented the largest portion of total shipments and employment in 1995, accounting for 34 percent of total shipments and 36 percent of employment. The power boiler and heat exchanger subsector and the electrical transformer subsector were the next largest components of the sector in terms of shipments and employment (see Figure 2).

Figure 2. Contribution of Subsectors to Electric Power Equipment Manufacturing, 1995



Source: Industry Canada estimates based on Statistics Canada data in Business Integrated Database (BID).

Electric power equipment manufacturers exported $1.5 billion in 1995, representing 46 percent of total shipments. Imports amounted to $2.3 billion. The domestic market, estimated to be total shipments minus exports plus imports, was thus valued at $4.0 billion.

Services to Electric Power

Services subsector employs 8 000 in consulting engineering design and contracting for power plants

Services to electric power include the activities of consulting engineers and engineering contractors as well as expert services provided by Canadian utilities. The design services performed by the large number of consulting engineering firms can be distinguished from the activities of some larger companies such as SNC-Lavalin, with 6 500 employees, and AGRA Industries Limited, with 5 000 employees, which can take on the role of EPC (engineer, procure and construct) contractor. An EPC contractor assumes full responsibility for a plant's construction and startup, generally on a fixed-price, turnkey basis, including design and procurement of subcontracted equipment and services, together with the construction and startup risks. In order to satisfy clients' demand for total project solutions, some of the larger EPC companies also offer full financing structuring and, in selected cases, are taking investment positions. Approximately 8 000 people are currently employed by Canadian companies delivering services to the electric power industry, according to consultations with industry representatives that took place in 1996.

In 1993 (the most recent year for which such data are available), there were 6 424 consulting engineering firms in Canada, which employed about 65 000 people and generated revenues of $5.6 billion, including exports of $554 million. The portion of these revenues received from services to power generation (the predominant portion of services to the electric power industry)

was $479.7 million, representing 8.1 percent of 1993 revenues for all consulting engineers. Exports of services to power generation are estimated to have been $44.8 million. (The figures presented in this *Sector Competitiveness Framework* are based on data from Statistics Canada, *Architectural, Engineering and Scientific Services, 1992 and 1993*, Catalogue 63-234-XPB, and are available only in respect of firms involved in power generation. Export figures are estimated by multiplying power generation's proportion of total revenues by total exports. These figures differ from those in the *Consulting Engineering Sector Competitiveness Framework*, which uses data from *Engineering News Record*, a major U.S. industry journal.)

Regional Distribution

85% of equipment manufacturing is located in Ontario, Quebec, where 60% of national power generation takes place

The electric power equipment and services sector exhibits characteristics of clustering, being highly concentrated in Ontario and Quebec and represented in other provinces to a much lesser extent. Generally speaking, manufacturing facilities are situated near sources of inputs and major markets. Sixty percent of Canada's power generation capacity is located in Ontario and Quebec, and approximately 85 percent of the equipment manufacturing takes place in these provinces.

Deregulation and competition counteract provincial preferences for local equipment suppliers

Provincial governments have customarily attached conditions to their procurement contracts, often requiring companies to set up manufacturing facilities within their respective provinces and causing a degree of fragmentation that has hampered efficiency in parts of the sector. (One variant of such arrangements is a requirement that the manufacturer sell a certain percentage of output outside the province, thus avoiding becoming exclusively reliant on a single customer.) Rationalization of the sector, however, has already curbed the effects of provincial preferences. The scope for applying any such conditions to contracts is probably going to be greatly reduced as deregulation and increasing competition force utilities to be more cost-conscious.

Contribution to the Canadian Economy

In 1995, the Canadian electric power equipment and services sector accounted for 0.7 percent of all Canadian manufacturing establishments, 1.0 percent of manufacturing employment, 0.7 percent of manufacturing shipments and 0.9 percent of manufacturing value-added.

Inputs represent about half of shipments value

For the electric power equipment sector, materials and supplies purchased from other industries represented about two thirds of total operating costs, or about 50 percent of shipments. The equipment manufacturers purchase material inputs such as steel, copper, aluminum and insulating materials, semi-finished parts (i.e. castings and forgings), and a large variety of electrical and electronic components and subcomponents. The Canadian content of these inputs ranges between 50 and 75 percent. For example, Canadian content in turbines is estimated to be

75 percent or higher. For generators, it is about 65 percent, as certain materials such as specialty or extra thick steels are not available in Canada. For power transformers, Canadian content used to be over 70 percent but, as a result of the North American Free Trade Agreement (NAFTA) and cost pressures, domestic content is trending downward to around 50 percent.

In recent years, there has been a trend to more outsourcing, which has increased the sector's reliance upon many other industrial sectors. This magnifies the importance of the performance of the major power equipment manufacturers, which represent an estimated market of about $1 billion for their suppliers. These manufacturers serve as the spearhead for their suppliers' entry into export markets. A number of SMEs, however, have penetrated export markets on their own or as joint venture partners of foreign companies.

Nuclear reactor sales reap large benefits, even when shared with international partners

The economic benefits of nuclear reactor sales are considerable although, typical of major deals in emerging markets, these benefits must often be shared with foreign players. The recent sale of two CANDU 6 reactors to China, for example, is estimated to be worth $4.0 billion. Canadian government financing being limited to $1.5 billion, the Canadian scope is likewise limited, and AECL is partnering with U.S., Japanese and Republic of Korea companies. In general, for major components such as the calandria (container for the moderator, usually heavy water, in pressure-tube reactors) and nuclear steam supply system, the Canadian content is about 80 percent because the CANDU product is designed, engineered and manufactured in Canada.

Ownership

Few large firms account for most activity and employment

Electric power equipment manufacturing is dominated by a number of large multinational corporations. These include Siemens, GEC Alsthom and ABB based in Europe; GE and Westinghouse (now part of Siemens) in the U.S.; and Hitachi, Mitsubishi and Toshiba in Japan. Most of the Canadian manufacturers are subsidiaries of these multinationals, which are also represented in Canada by sales offices that can book orders to be filled by their operations elsewhere. The Canadian-owned manufacturers tend to be smaller and produce specialty and niche items.

Multinational ownership of Canadian plants opens access to capital but may constrain exports

In many cases, Canadian production facilities have been acquired through buyouts of Canadian plants. The consequence is a mix of benefits and constraints. On the one hand, Canadian subsidiaries benefit from their parents' access to capital and leading-edge technology. On the other hand, they may be constrained by the parent from participating directly in some foreign markets. As well as having to adhere to geographic limits on their activities, certain subsidiaries are restricted to those projects for which they have obtained financing from the Canadian International Development Agency (CIDA) or the Export Development Corporation (EDC). It can readily be seen that the influence and role of Canadian subsidiaries within their respective multinational corporations are crucial to the development of the Canadian industry. The

capacity of subsidiaries to grow and to make a significant contribution to the Canadian economy can be greatly enhanced by negotiating and winning international mandates for designated products.

Canadian ownership dominates services subsector

The ownership of the companies supplying services contrasts markedly with that of the manufacturers. Almost all consulting engineering firms based in Canada and working on electric power projects are controlled by Canadians.

Research and Development

Utilities are leading investors in R&D

In Canada, the leading role in research and development is undertaken by the provincial utilities, which work closely with the equipment suppliers. Hydro-Québec and Ontario Hydro had the sixth and eighth largest company R&D expenditures, respectively, in Canada in 1995. In 1995, Hydro-Québec spent $148.2 million and Ontario Hydro spent $117.0 million. There is also a substantial program of nuclear R&D, in which AECL and Ontario Hydro are the major participants. AECL spent $159.3 million in 1995, making it the fourth largest corporate R&D spender in Canada. The Canadian Electricity Association (CEA) helps to coordinate some utility R&D, and electric power research is also supported by the federal government's Panel on Energy R&D (PERD).

Relatively little basic research is undertaken in Canada. The equipment manufacturers that are subsidiaries of multinational corporations are able to access the R&D operations of their parents. In consequence, a large portion of domestic R&D is concerned with adapting foreign designs to meet Canadian requirements, climatic conditions and unique local needs.

Cooperative Activities

Partnerships support bid making and promote long-term objectives

Some of the relationships entered into by sector companies are for the purpose of making specific project bids; others are of a more long-term nature. Engineering and contracting firms have formed a number of consortia, such as Canadian International Water & Energy Consultants, a hydro consortium in which Acres International and SNC-Lavalin are partners. Two such consortia are intended to support CANDU projects: Canatom Inc., an architect-engineer providing engineering, procurement, project and construction management and consulting services; and NPM Nuclear Project Managers Canada Inc. (of which AECL is a co-owner), which provides project and construction management, commissioning management and procurement services, as well as training and technical support for foreign CANDU sales.

Informal exchanges of view on policy issues have been on the increase. The National Electricity Roundtable (NER) was established in 1994, reflecting the view of major electric power utilities, leading power equipment manufacturers and several consulting engineering firms that they share many common interests and must cooperate more intensively. The NER serves as a network joining different parts of the industry and enabling a more useful dialogue with government.

Associations promote special interests of sector firms

There are a number of other associations serving specific groups or interests. Electro-Federation Canada represents over 175 manufacturers and about 50 distributors. The federation's principal activities are the international harmonization of electrical standards, statistics gathering and dissemination, and government relations. The Canadian Nuclear Association (CNA) and the Organization of CANDU Industries (OCI) are the principal associations in the nuclear sector. The CEA is the national forum and voice of the electric utilities, although its membership also encompasses manufacturers and consultants. In Quebec, the principal association is Le Club de l'Électricité du Québec. There are organizations representing the interests of IPPs in a number of provinces, the largest of which is the Independent Power Producers' Society of Ontario (IPPSO). The Association of Major Power Consumers of Ontario (AMPCO) has been formed by large industrial energy consumers. Organizations have also been established by the suppliers of emerging technologies. Consulting engineers are represented by the Association of Consulting Engineers of Canada (ACEC).

2.3 Performance

Operating Costs

Labour costs are higher portion of sector operating costs than for total manufacturing

In 1995, the distribution of operating costs for electric power equipment manufacturers was in line with that in sectors producing similar products and was fairly similar to that in manufacturing as a whole (Table 1). Wages and salaries represented about one third of total operating costs and 42 percent of total value-added whereas, for manufacturing as a whole, wages and salaries represented one fifth of total operating costs and 37 percent of total value-added.

Table 1. Operating Costs[a], 1995

	Fuel and electricity	Wages and salaries	Materials and supplies
		(percent)	
Electric power equipment	1.3	30.0	68.7
Machinery (SIC 31)	1.2	27.8	71.0
Electrical and electronic products (SIC 33)	0.7	18.8	80.5
Manufacturing	2.6	18.2	79.1

[a] Operating costs = the sum of fuel and electricity costs, wages and salaries, and the costs of materials and supplies.

Source: Industry Canada estimates based on Statistics Canada data.

Rationalization and Consolidation

Mergers and restructuring have removed much excess capacity, though some persists

The sector's recent record of performance has been compiled against a backdrop of rationalization and consolidation, marked by a wave of plant closings in the early 1990s. Companies have sought to eliminate duplication in factory overhead and increase economies of scale by concentrating production in one location. Similar restructuring has been experienced throughout the major industrialized countries, where most of the productive capacity in this sector is located. The most visible manifestations of rationalization have been the mega-mergers of the late 1980s, between GEC of the U.K. and Alcatel Alsthom of France to form GEC Alsthom, and Asea of Sweden and BBC Brown Boveri of Switzerland to form ABB. Excess capacity persists at the global level, particularly in respect of gas turbine production facilities, and more rationalization can be anticipated.

Former high tariffs sparked foreign investment

Many foreign-owned multinationals established plants in Canada in order to circumvent high import tariffs and to take advantage of Commonwealth preferential duties. Even subsequent to the Kennedy Round of multilateral trade negotiations under the General Agreement on Tariffs and Trade (now known as the World Trade Organization), which concluded in 1967, Canadian most-favoured-nation (MFN) tariff rates for electric power equipment were in the range of 15–20

percent. By the time of the implementation of the Free Trade Agreement (FTA) between Canada and the United States on January 1, 1989, Canadian tariffs for electric power equipment were still fairly high, in the range of 9.2–15 percent. U.S. tariffs were in the range of 0–7.5 percent.

Low tariffs stimulate trade

Canada's economy has since become more open. Under the FTA, some Canadian and U.S. tariffs were dropped immediately upon implementation, with the remaining tariffs phased out over five or 10 years. In the first five years of the decade, trade in goods and services increased from 50.8 percent to 72.3 percent of GDP. The FTA was later superseded by the NAFTA, implemented on January 1, 1994, which included Mexico. Trade between Canada and the United States continued to be governed by the tariff phase-outs negotiated under the FTA.

Overall demand for new facilities drops

The market pressures consequent upon lower tariff barriers and diminished non-tariff barriers have been compounded by a drop in the demand for new power generation facilities. This is a dramatic change for North America, where the demand for power and the associated derived demand for power equipment and services grew in step with the rapid expansion of the North American economy during the past three decades. From 1971 to 1995, the total capital investments made by the electric utilities increased from about $1.8 billion to $7.6 billion, with an average annual growth rate of 6.3 percent. However, this trend conceals a decrease in the early years of the current decade; the utilities' retrenchment shows in the decline of their capital investment after 1992–93 (Figure 3).

Figure 3. Capital Investment by Electric Utilities

Source: Canadian Electricity Association and Natural Resources Canada, *Electric Power in Canada*, 1995, p. 105.

The electric power equipment and services companies have been given further cause to anticipate reduced appetites for investment on the part of the utilities by signs of their deteriorating financial performance. As Table 2 shows, the utilities' operating profits and profit margins decreased from 1991 to 1995. The financial performance of the utilities was markedly weaker than that of non-financial industries as a whole, which can be partly attributed to increases in the real costs of long-term borrowing by this capital-intensive industry.

Table 2. Financial Performance of Electric Utilities

	1991	1992	1993	1994	1995
			(Percent)		
Electricity sector					
Profit margin[a]	41.25	40.35	28.85	27.15	26.82
Return on equity[b]	8.09	8.72	–8.51	–7.42	–8.47
Return on assets[c]	1.49	1.64	–1.43	–1.22	–1.20
Total non-financial industries					
Profit margin	4.51	4.28	4.66	5.96	6.63
Return on equity	1.93	0.77	3.22	6.32	7.41
Return on assets	0.62	0.25	1.02	2.05	2.44

[a] Profit margin = operating profit divided by operating revenue.
[b] Return on equity = profits before extraordinary gains divided by total shareholder's equity.
[c] Return on assets = profits before extraordinary gains divided by total assets.

Source: Statistics Canada, *Financial and Taxation Statistics for Enterprises*, Catalogue No. 61-219XPB.

Falling demand forces rationalization, outsourcing, competition abroad

Faced with declining demand, at least in comparison with the situation a few years ago, the equipment producers have been forced to shed unused capacity, reduce prices, concentrate on their most profitable products and try to improve their productivity by building core competencies and relying more heavily on external suppliers. Subsidiaries serving only the Canadian market have been closed or reduced in size, and their market shares taken over by their parents' other operations. Increased specialization has meant that Canadian companies in the sector do not directly compete among themselves so much as with each other's affiliates located abroad or in the U.S.

Continental rationalization shifts job locations

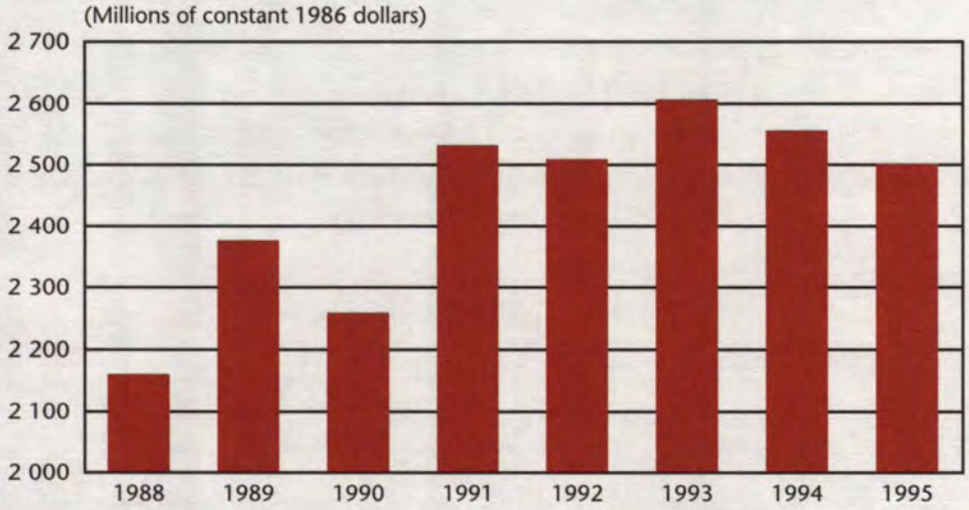
Decisions on rationalization and consolidation have normally emanated from the head offices of multinational companies and have been structured on a continental basis. For example, McDermott International in 1996 decided to concentrate engineering, sales and marketing for its Babcock & Wilcox Power Generation Group in Barberton, Ohio, meaning the loss of hundreds of jobs at B&W's Cambridge, Ontario, plant. It would be a mistake, however, to think that employment and production in Canada have always suffered as a result of rationalization. The closing of the Westinghouse factory in Pensacola, Florida, and the transfer of its production mandate to other plants including the Hamilton, Ontario, plant had the opposite effect.

Growth

Though exhibiting considerable volatility (Figure 4), total shipments of Canadian electric power equipment increased by 16 percent from 1988 to 1995, reaching a total value of $2.5 billion in 1995, measured in constant 1986 dollars, or $3.2 billion in current dollars. The increase was particularly strong on the part of the turbine and power boiler subsectors. In that eight-year period, shipments of electric power equipment increased more rapidly than shipments for total manufacturing, which grew by 11 percent. Increasing exports and a long time lag between orders and shipments explain the high levels of activity that have been experienced, despite the recent reduction in investments by domestic utilities, which has triggered the sector's concern about overcapacity.

Power equipment shipments have risen faster than for total manufacturing, despite investment reduction

Figure 4. Canadian Electric Power Equipment Shipments



Source: Industry Canada estimates based on Statistics Canada data in BID.

The overall performance of Canada's consulting engineering firms recently has been strong. Revenues increased from $4.3 billion in 1988 to $5.9 billion in 1993, amounting to 37 percent growth over the period. The largest firms tend to have between 10 and 20 percent of their billings in electric power services. These firms have, however, felt the effects of declining domestic demand for electricity capacity, particularly as large projects such as the James Bay hydro-electric development have started to wind down. Revenues from services to power generation were valued at $213.9 million in 1988, nearly tripled to $622.6 million by 1992, then contracted to $479.7 million in 1993.

Services revenues fall as domestic development projects wind down

Trade

Foreign markets compensate for overall domestic decline

Canada's dependence on foreign markets and foreign suppliers has increased in recent years. The electric power equipment and services sector has emulated the national economy in this respect. Exports of electric power equipment (measured in constant 1986 dollars) increased from $570 million in 1988 to $1.2 billion in 1995, while exports as a percentage of shipments increased from 26 percent to 46 percent. Imports increased from $926 million in 1988 to $1.8 billion in 1995, with their share of the domestic market rising from 37 percent to 57 percent.

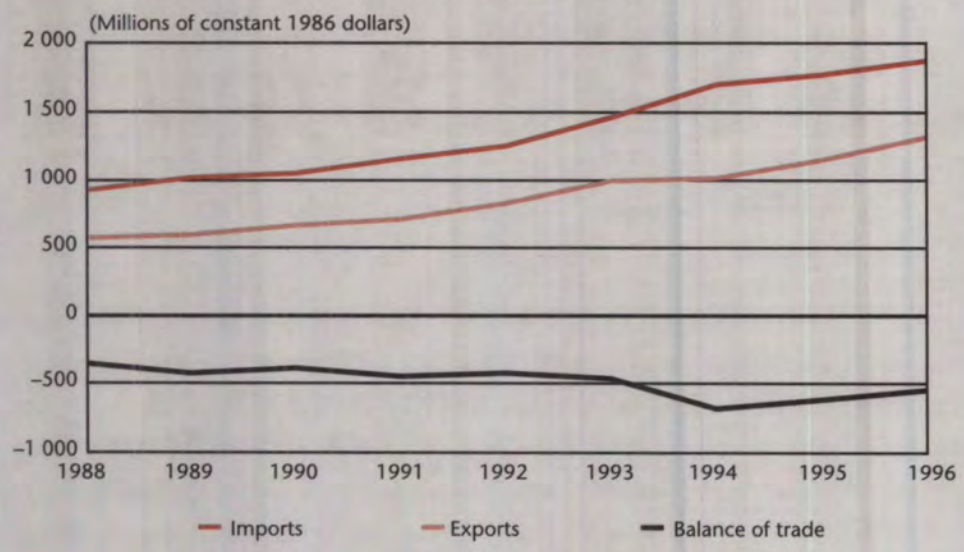
Specialization increases Canadian competitiveness, makes room for increased imports

The increase in imports can be attributed to the reduction of Canadian supply capability as part of rationalization and consolidation. The plants that remain in Canada, being more specialized with niche technologies and in a number of cases with product mandates, are more competitive and better positioned to enjoy success in export markets.

High import levels increase trade deficit, with some recent easing

In recent years, high levels of imports have led to a consistently negative balance of trade in electric power equipment (Figure 5). The deficit increased from $356 million in 1988 to $682 million in 1994 (measured in constant 1986 dollars). Most subsectors, especially the turbine and mechanical power transmission subsector, experienced declines in their balance of trade over this period. Since 1994, the balance of trade has seen some minor improvement.

Figure 5. Trade Performance



Source: Industry Canada estimates based on Statistics Canada data in BID.

Canadian strengths are custom designs with high labour content

Canadian firms tend to be more competitive in export niches, which include custom-designed installations or packaged units of medium to high technological complexity where the labour content is relatively high (or where there is an opportunity for Canada's unique nuclear technology). Canadian firms tend to be less competitive in commodity products such as switchgear and cable, as the domestic market is too small and too fragmented to accommodate the optimum scale of production.

Canadian services grow in international importance

A growing number of Canadian consulting engineering firms are becoming international players. In 1995, Canadian firms accounted for 5.8 percent of total billings worldwide in the power sector. To take one example of exporting success, Teshmont Consultants Inc. has capitalized on the expertise it acquired in high voltage direct current (HVDC) transmission in Manitoba by winning several projects in China, including one to transport power from the Yangtze River's Three Gorges hydro-electric plant to Shanghai. Canadian engineers are active in every important regional market, including those that are scarcely, if at all, served by the equipment manufacturers.

U.S. accounts for three quarters of Canadian trade . . .

The United States is easily Canada's major trading partner, owing to, among other factors, low freight costs, a high proportion of U.S. branch plants in Canada and free trade. In 1995, some 79 percent of Canadian exports of electric power equipment were destined for the U.S. market, and 71 percent of Canadian imports were sourced from the U.S. Far behind as export destinations come the Republic of Korea, the United Kingdom, Thailand, Venezuela, Taiwan and China. Other significant sources of imports are the U.K., Italy, France and Japan.

. . . influenced by U.S. offshore markets

The figures for bilateral trade with the U.S. are greatly influenced by internal activities of multinational corporations. A large volume of exports are first shipped to the U.S. for final assembly and packaging and then to offshore markets. This does not diminish the importance of the U.S. as a trading partner, but Canada is indirectly impacted by offshore export markets more than the data would indicate.

Canadian exports of power equipment to Mexico have been minimal but the NAFTA has opened up the Mexican market for Canadian producers as well as for U.S. producers. Mexican tariffs for electric power equipment were previously in the range of 10–20 percent. Under the NAFTA, Mexican and Canadian tariff reductions are being phased out over periods of up to ten years, with the exception of tariffs on certain equipment, which were eliminated upon implementation. The NAFTA will also eliminate most Mexican import licensing requirements and open up government procurement opportunities in Mexico. As the Mexican economy improves, demand for electricity will grow and will result in higher derived demand for electric power equipment and services.

Canada–Chile agreement opens new market

Canada recently concluded a bilateral trade agreement with Chile. Under the agreement, which was implemented on July 5, 1997, all Canadian tariffs and almost all Chilean tariffs were eliminated immediately. Chilean tariffs of 11 percent applicable to certain wire and cable products are to be phased out by 1999. The Chilean market represents an opportunity for Canadian exporters.

Korea and China are major markets for Canadian equipment suppliers

The Canadian sector has scored successes in markets outside the western hemisphere. The sale of four CANDU nuclear reactors to the Republic of Korea and the most recent sale of two reactors to China are examples. In China, the Geheyan Project (1 280 megawatts) was constructed by a Canadian consortium, and General Electric Canada has supplied turbines and generators to the Ertan Project (3 300 megawatts). GE has recently received a large contract to provide turbines and generators to the Three Gorges Project (18 200 megawatts). Babcock & Wilcox, through a joint venture, is the fourth largest supplier of boilers in China. CAE has been selling automated control systems to Chinese hydro-electric power stations since 1985.

WTO reduces tariffs by average of 40% overall

China's accession to the World Trade Organization (WTO) and thereby to multilateral trade disciplines is still being negotiated, but access to other markets was enhanced by the Uruguay Round of multilateral trade negotiations under the former General Agreement on Tariffs and Trade, which concluded in 1994 and resulted in unprecedented tariff reductions. Industrial countries agreed to make a 40 percent overall reduction in tariffs on industrial products, including electric power equipment (see Table 3). On average, tariffs on industrial products fell from about 6.3 percent to 3.8 percent. Tariff reductions on electric power equipment are being phased in over a five-year period.

Table 3. Pre- and Post-Uruguay Round MFN Rates for Selected Countries[a]

Product	Canada		United States		European Community		Japan	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post
				(Percent)				
Boilers and heat exchangers	9.2 to 12.5	6.1 to 8.2	3.9 to 7	2.6 to 5.6	4.1 to 6.2	2.7 to 5.7	0 to 6.5	0
Turbines and mechanical power transmission	0 to 15	0 to 9.7	3.7 to 7.5	0 to 6.7	5 to 6.2	2.7 to 4.5	4.3 to 7.2	0
Electrical transformers	9.2 to 17.5	0 to 11.3	2.4 to 3	0 to 2.4	4.4 to 6.5	2.2 to 3.7	4.9 to 5.8	0
Electrical switchgear and protective equipment	3.9 to 17.5	0 to 11.3	5.3 to 10	2 to 9	4.1 to 4.9	2.1 to 2.7	0 to 4.2	0
Energy wire and cable	0 to 10.2	0 to 6.7	4.9 to 8.4	2.6 to 8.4	6.5	3.3 to 3.7	7.2	4.8
Generators	9.2 to 15	6.1 to 9.7	2.8 to 3	0 to 2.5	4.1 to 5	1.7 to 2.7	4.2 to 5.8	0

[a] Some Canadian MFN duties were reduced further than WTO concessions for inputs in order to match U.S. MFN rates on these goods. These tariff reductions were designed to lower costs and thus improve the attractiveness of Canada as a place to invest and to improve the competitiveness of Canadian companies.

Source: Industry Canada estimates.

Tariff binding increases security of access

Another notable achievement of the Uruguay Round was the increased commitment to the binding of tariffs. (This affords security of access because a country binding a tariff cannot increase it without negotiation.) Both developed and developing countries agreed to bind a substantial portion of their tariffs. This is especially significant with respect to the tariff rates of developing countries, which tend to fluctuate dramatically over short periods of time.

Significant non-tariff barriers remain with U.S. state and local governments

Government procurement practices are a particularly significant non-tariff barrier for electric power equipment trade. Under the NAFTA, there are greater opportunities for Canadian firms to sell to the Mexican and U.S. governments, although major barriers still remain. Access to Mexican projects is still subject to certain restrictions that will be phased out over 10 years. The NAFTA does not extend competitive tendering disciplines to state and local governments, nor does it eliminate the legislated preferences that benefit small and minority businesses under the U.S. government's Small and Minority Business Set-Aside Program, or improve Canadian access to purchases of electrical equipment by the major U.S. federal power utilities such as Bonneville Power and the Tennessee Valley Authority.

Central government procurement restrictions are easing

The Uruguay Round negotiations resulted in an Agreement on Government Procurement to supersede the Procurement Code that had been in place since 1981. The new agreement covers a broader range of central government departments and agencies. Participating governments are negotiating coverage of purchases by subcentral and local governments and are continuing to discuss the potential for coverage, on the basis of reciprocity, of government corporations, public utilities and municipal departments and agencies.

Employment and the Labour Market

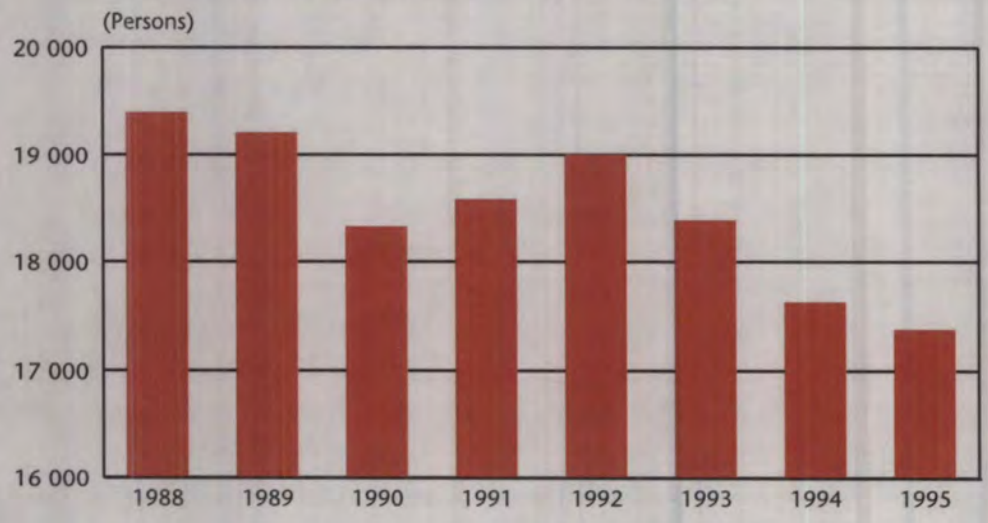
Leading employment subsectors are turbines, transformers, power boilers

The labour force employed by the electric power equipment manufacturers in 1995 was equivalent to 1 percent of the total number of manufacturing jobs in Canada. Employment was highest in the turbines subsector, with a total of 6 217 employees or 36 percent of the total. This was followed by the transformers subsector with 3 968 employees (23 percent of the total) and the power boilers subsector with 3 007 (17 percent).

Sector employment trends steadily down

Employment in the manufacture of electric power equipment in Canada declined over the 1988–95 period (Figure 6). In 1995, it was down by 10 percent from its 1988 level. Employment declined as a result of technological change, restructuring and rationalization.

Figure 6. Employment Levels in Canadian Electric Power Equipment Manufacture



Source: Industry Canada estimates based on Statistics Canada data in BID.

Between 1988 and 1995, wages and salaries per employee, measured in constant 1986 dollars, were higher for the Canadian electric power equipment manufacturers than for total manufacturing. For electric power equipment manufacturers, constant-dollar wages and salaries per employee increased from $27 200 in 1988 to $30 100 in 1995, an increase of 11 percent over the period. Constant-dollar wages and salaries for the manufacturing sector rose from $26 900 in 1988 to $28 400 in 1995, an increase of 6 percent.

Wages/salaries remain higher than for total manufacturing

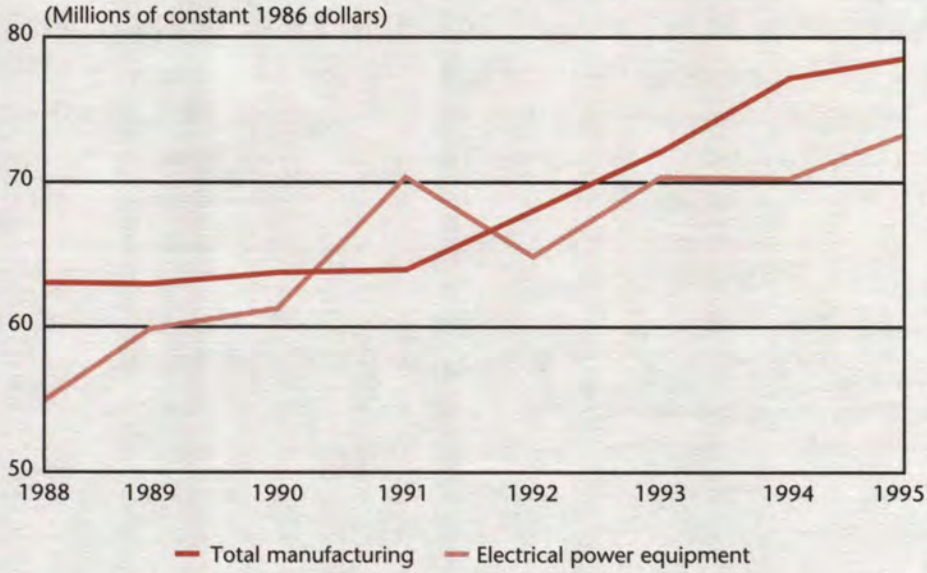
Labour productivity for the electric power equipment manufacturers, as measured by value-added per employee in constant 1986 dollars, increased from $54 000 in 1988 to $73 700 in 1995, an increase of 37 percent from the 1988 level. While labour productivity experienced an upward trend over the period, it was somewhat volatile, with a significant peak in 1991.

Value-added per employee averages 5.3% increase per year

These increases in real earnings and labour productivity could reflect improved management and/or a growing proportion of skilled workers. This trend is by no means restricted to the electric power equipment and services sector, and has been furthered by increased outsourcing.

With the exception of 1991, labour productivity for electric power equipment manufacturers trailed that of total manufacturing (Figure 7). However, the situation was reversed with regard to the growth rate of labour productivity from 1988 to 1995, which was 25 percent for total manufacturing and 37 percent for the equipment manufacturers.

Figure 7. Comparison of Labour Productivity Levels in Electric Power Equipment Manufacturing and Total Manufacturing



Source: Industry Canada estimates based on Statistics Canada data in BID.

3 CHANGING CONDITIONS AND SECTOR RESPONSE

Flattening of world demand for electric power gives rise to overcapacity

The business environment of the electric power equipment and services sector has changed dramatically since the beginning of the decade. The buildup of generation capacity during the 1980s, coupled with the recent flattening of demand for electric power, has led to manufacturing overcapacity in the developed world. In contrast, developing countries have an immense appetite for energy but their ability to pay is limited. This has led to rationalization on the part of the suppliers and fierce competition for projects in developing country markets. Financing has become the key to securing contracts.

3.1 Evolution of the Electric Power Industry

Monopoly status for utilities gave equipment suppliers stable markets

Until recently, utilities in North America were uncontested natural monopolies, passing on their costs of doing business under cost-plus regulation, taking advantage of economies of scale, integrating and synchronizing the complex functions of generation, transmission and distribution; they were obligated to provide reliable service along with equitable access and rates. They benefited from a comparatively low-risk environment that enabled them to undertake long-term planning of their investments in new capacity. In turn, the equipment suppliers aligned their own strategies with their customers' circumstances, building close relationships that helped them anticipate the utilities' needs. This led to the design of highly customized products with long lead times for delivery.

Deregulation, restructuring led customers to alter expectations and demand better services

Over the past two decades, forces took shape that would force a re-evaluation of existing practices and structures in most industrialized country markets and, to a lesser degree, in emerging markets. This re-evaluation generally favoured greater competition. Public policy led the way. The movement for change gathered strength from legislation to encourage the development of efficient technologies or energy conservation, such as the *Public Utilities Regulatory Policies Act* of 1978 in the U.S., and from the Thatcher government's privatization of much of the British energy sector. The example set by the deregulation of airline and telephone industries added to the momentum. Private enterprise and technological innovation also played important roles. Confronted by rising electricity rates, customers began to demand price concessions and better service from their utilities, sometimes threatening to relocate plants or even to generate electricity themselves. Equally important, the potential for competition was demonstrated by the development of small, modular, clean, gas-turbines that produced electricity at lower cost than the larger units of the utilities, which made it cheaper to break into the market.

A free market in which prices are set by supply and demand and customers choose their electricity supplier much as they select their long distance telephone provider, bank or airline is now widely viewed as the instrument to achieve lower costs and greater efficiency. Progress toward this end is by no means smooth in Canada. Completion of an energy chapter for the Agreement on Internal Trade would considerably accelerate market liberalization.

Freer market expected to bring lower cost, greater efficiency

There is a widespread conviction that restructuring, where it has not already occurred, is inevitable, as witnessed by a more energetic drive for customers on the part of both utilities and equipment suppliers. Impending competition is likewise forcing all utilities to understand the costs, revenues and profitability of each segment of their business. The "unbundling" of utilities' functions may well follow and these could re-emerge as four distinct businesses: electricity producers; transporters; wholesalers, marketers and traders; and retail marketers. Thanks to the emerging ability to "wheel" power across jurisdictions separating buyer and seller, new markets will open up and formerly captive markets will have to be defended. The Canadian utilities that have substantial resources of hydro power are well positioned to take advantage of an expected increase in cross-border electricity trade.

Restructuring and competition may bring industry segmentation as services are unbundled

Less fortunate utilities, however, confront uncertain prospects for survival in the new environment. Many face the problem of recovering "stranded assets" in which capital funds were invested in the past but which no longer command a price close to their book value. Until competitive markets are in operation, utilities may avoid making investments in new generating capacity, particularly large baseload plants, for fear that shareholders will view these as unacceptable risks. In the event that additional demand materializes, utilities may seek joint venture alliances with IPPs. Those utilities that choose to build and increase their rate base may adopt such strategies as adding peaking capacity, repowering existing plants, or building co-generation plants to serve major industrial customers.

Some utilities may be forced to reduce investment levels

The structure of the industry is expected to alter markedly. A pattern has been set by the deregulation of the U.S. telephone industry, which led to the reintegration of AT&T's successor companies (the "Baby Bells") and conglomerates being formed by telecom, entertainment and publishing companies. A fully integrated North American power market will require corporate entities with deep pockets and a wide mixture of market products and skills to enable them to survive. There are already signs of new alignments between industry players, particularly mergers between electric and gas companies driven by the intention to offer the customer a wider range of energy products. The acquisition of a substantial stake in Gaz Métropolitain by Hydro-Québec foreshadows a formidable force that is intended to gain market share in the United States (while the two companies continue to compete at home). More ambitious forms of convergence, possibly combining energy services with telecommunications, may well stand on the horizon.

New mergers are expected as electric and gas utilities converge

Higher returns on investment will be required to compensate for higher risk for generation and transmission

If competitive forces are permitted free play, business strategies will focus on achieving lowest cost, improved technologies and performance and on serving the customer. It will be imperative to make the most efficient use of generation and transmission assets. In order to meet the constantly changing requirements of customers, short lead times for matching resources to demand and flexibility of generation and transmission systems will be required. The demand for peaking power can be predicted to increase, and with it the market for small-scale distributed generation. The successors to the utilities — generation and transmission companies — will seek a higher return from investments to compensate for greater risk and shorter pay-back periods.

Equipment suppliers will have to offer more aftermarket services and form strategic alliances

As the utilities become leaner and more highly reactive, equipment manufacturers are also going to have to change their strategies to gain and keep competitive advantage. The way to get business will no longer be to build long-standing relationships with nearby utility customers. Cost and customer service will matter infinitely more, and the latter will be looked upon as a significant source of profits. Engineering and construction firms will be asked to build turnkey plants, at a firm price and with guaranteed performance. Manufacturers will need to improve their technology and product designs to enable the utilities to lower operating and capital costs and meet environmental requirements. Canadian companies that have demonstrated considerable competence in making customized products will find that they have to resort to standardized designs. As manufacturers are having to do already, they will devise packages of aftermarket services, including contracts that permit customers to build predictable maintenance costs into their business strategies. Customers will insist on short lead times, strong support services, flexibility in product offerings (possibly including equipment leasing) and performance guarantees. Motivated by the need to gain greater flexibility and manage their risks, manufacturers will establish strategic alliances. They may also have to share the risks of project developers by providing financing or taking on operational responsibilities themselves.

3.2 Technological Change

Technological progress in electric power generation and transmission recently has been steady rather than dramatic. The major replacement technology introduced has been the gas turbine. The large equipment suppliers have fiercely competed to increase thermal efficiencies, now at around 60 percent, of combined cycle gas turbines.

Technological leadership has come from the major utilities, which have developed specifications for projects that engineering companies and manufacturers have had to match with the necessary expertise and technologies. The preponderant part of the manufacturers' R&D has been aimed at incremental improvements in existing products and processes, but they have also had access to their parents' state-of-the-art technology. Illustrative of the close relationships that have been formed between manufacturers and their customers, the two have occasionally worked together on joint projects. For example, the technology for a next-generation transformer that is about to be marketed around the world was developed by Hydro-Québec and Asea Brown Boveri, working in adjacent facilities and splitting the costs with the intention of similarly splitting the royalties.

Manufacturing R&D focusses on meeting utilities' specifications, sometimes through joint ventures

Technology is playing a crucial role in a restructuring electric power industry. Cost pressures are dictating an emphasis on increasing the performance of the infrastructure in place, which in turn puts a premium on technologies that can be used to monitor equipment status, analyze the information received and communicate it to managers. The requirement for flow control, system stability and capacity enhancement is motivating interest in flexible AC transmission systems (FACTS), based on power electronic devices that can carry large amounts of power at high voltages and provide greater speed, precision and reliability than previously used switching devices.

Competition among large power providers gives impetus to change in transmission technology to link sellers and buyers most efficiently

Though the structure of a competitive industry is far from clear as yet, new players, marketers and resellers of electricity are already appearing in the U.S., reflecting a customer-driven emphasis on energy services. As electricity becomes more and more like any other commodity, these new players will try to interest potential purchasers in customized products, such as energy audits, technology assessments, and troubleshooting and consulting services. The importance that customers place on reliability and security will broaden the market for computer-based surveillance, control and data acquisition (SCADA) systems, which are being integrated into power systems controls and power management, extending from generation to consumer metering.

Power customers demand more services, stimulate development of new systems

A second trend in technology development is represented by the emerging (mostly renewable) technologies such as wind power, fuel cells, biomass gasification and photovoltaics. These technologies accounted for only 1 percent of total generation in 1994 and, generally speaking, their up-front capital costs are still too high to permit commercial production on a significant scale. Their use, however, can greatly reduce the environmental costs of electricity generation. Certain emerging technologies, particularly fuel cells and small gas turbines, are well suited to fill a growing requirement for distributed generation and customized energy services. They are

Lower environmental cost of electricity generation drives development of emerging technologies

finding specialized applications, often in remote locations and in ways that complement the major electric power generation technologies, such as the adaptation of turbines for biomass. Wind power is making big inroads in Denmark, as is energy from biomass in Sweden.

Canadian activity in technology development remains small . . .

Are the electric power equipment companies staying abreast of these trends and able to turn them to advantage? Five areas have been identified by the National Electricity Roundtable as priority targets for technology development in Canada including R&D investments: distributed generation technologies, power quality technologies, transmission and distribution control technologies, environmental technologies used in the production of electricity, and electric-power-based transportation technologies. Canadian activity in these areas ranges from modest to non-existent. If the conditions for competition in Canada's power market were fully established, that would spur suppliers to develop and apply new technologies. Suppliers must be able to make a strategic, market-based business case for developing and manufacturing new technologies in their Canadian operations. Otherwise, the foreign multinationals will tend to develop them at home, despite Canada's favourable R&D tax credit regime.

. . . with little support for research from utilities or governments

Moreover, the prospects of technological development being fed by new research are not strong. Eager to cut costs and having no large projects on the drawing board, utilities are surrendering some of their technological leadership. According to Statistics Canada (*Industrial Research and Development*, Catalogue No. 88-202, various years), their R&D investments have been declining in the 1990s, and the research they are undertaking is being pushed closer to the market. At the same time, government research budgets are constrained and, in consequence, very little pre-competitive research or research on emerging technologies is being done in Canada.

Canadian power equipment suppliers need to stay ahead of overseas customers before they become competitors

Locating technology development in Canada is crucially important if the present manufacturing base is to be maintained. An additional motive for stimulating the flow of new technology is that overseas buyers are increasingly requiring technology transfer as a condition of contracts for power projects. The intent of these buyers is to build domestic capabilities in infrastructure development and construction, thereby reducing reliance on imported equipment and the associated requirement for foreign exchange, with the eventual goal of creating a local high technology industry capable of exporting. Thus, the Canadian sector is faced with the need to stay one step ahead of its overseas customers so that they do not become the competition.

3.3 Export Development

Export sales are the key to growth and survival of the Canadian electric power equipment and services sector. (The other obvious growth strategy — meeting import competition — is less effective because multinational equipment manufacturers have required their Canadian operations to specialize.) Demand for electric power capacity in the developing regions of Asia and Latin America has resulted in a fundamental shift in focus by the sector toward offshore markets. However, anemic domestic market conditions in other industrialized regions such as the U.S., Japan and Europe have caused a similar shift in focus by Canada's competitors, resulting in intense competition between the world's major suppliers. This competition has recently forced price compression of between 5 and 7 percent per year.

Export sales hold most promise for industry growth, especially in Asia, Latin America

Markets with the largest stated potential are not necessarily those with the best prospects for sales. For example, while India plans to add 57 000 megawatts of new capacity, only 12 000–15 000 megawatts may actually be achieved because of domestic political and policy constraints. Such markets are also often difficult to access. There are a range of barriers that vary from country to country including tariffs on imported equipment, registration protocols for foreign suppliers, political and jurisdictional complexities, unfamiliar local business practices, complex and poorly defined regulatory hurdles, unstable and underdeveloped financial and legal infrastructures, foreign exchange risks, return on investment restrictions, taxation regimes and preferences for domestic suppliers.

Markets with largest potential may not be suitable prospects for Canadian firms

Private Power

The global power market has recently experienced a shift toward "private power." Traditionally, government-owned electric utilities would solicit bids on various components of a major power project from suppliers around the world. Contracts would be negotiated and awarded and foreign suppliers would then arrange financing through the export credit agency (ECA) in their home country. The key ingredient in the financing arrangement was the provision of a "sovereign guarantee" by the host government, removing many of the risks associated with supplying equipment for international capital projects. The host utility would own the project throughout its construction and operate it upon completion.

Host governments in developing countries no longer have the debt capacity to provide sovereign guarantees for all their planned power projects. Fortunately for them, fierce competition between the multinational equipment suppliers has made it possible to do without such guarantees. New and innovative project structures have emerged, such as Build-Own-Operate (BOO) or Build-Own-Transfer (BOT) or Build-Own-Operate-Transfer (BOOT), all of which require the

"Private power" is on the increase in developing countries

contractor not only to build the power plant but also to assume much of the risk, possibly over an extended period. According to Cambridge Energy Research Associates, private power is expected to account for between one third and one half of all new power projects outside North America in the next decade. This is impressive growth, considering that private power was practically unknown 10 years ago. Adding to the risks of investment in electric power is the emergence of the merchant plant, which possesses no secure long-term power purchase agreement but generates to meet demand.

Overseas opportunities for turnkey projects by Canadian developers require assuming significant risk

New players in the market are project developers or project integrators, who raise large sums of money from private and public sources. They offer a project authority a turnkey contract to design, build, finance, own and operate an entire project, and sell power to the host electric utility. The developer assumes all risks at the time the contract is awarded and then seeks to spread the risk as much as possible among members of a consortium. Canadian suppliers attempting to sell into this market must, in addition to offering the best price, be prepared to bear a significant portion of the project risk by, for example, taking equity positions. In many cases, the ability of suppliers to secure financing has become a prerequisite to being considered for international power contracts.

Export Financing

Financing for international power projects comes primarily from three sources: international financial institutions (IFIs), such as the World Bank and the Asian Development Bank; private sources such as banks and pension funds; and ECAs such as EDC in Canada, U.S. EXIM Bank and Japan EXIM. Canadian suppliers need to leverage all three of these sources in order to offer sufficient longer-term debt and equity financing in their bid packages.

IFI Financing

Services benefit more than manufacturers from IFI financing

Power projects have long been a core line of business for the IFIs. Canada has enjoyed mixed success during the past decade in securing IFI funded capital project contracts, ranking twelfth among IFI members with 1.7 percent of total IFI procurement, compared with a 2 percent share of contributions. Since 1991, Canada has received 86 cents in procurement contracts for every dollar contributed, winning 1 percent of equipment supply contracts and a much more impressive 7 percent market share in consulting engineering services. The recommendations of the federal government's Interdepartmental Task Force on IFI Procurement are currently being implemented with the goal of improving the Canadian performance.

Private Financing

The inability of offshore capital projects to attract significant amounts of Canadian private sector finance represents an impediment to increased exports, especially in the growing market for IPPs. Canada's chartered banks are becoming more active in the financing of global power projects, though so far a lot of this activity has been restricted to acting as advisors in such transactions. There are fewer indications of similar activity on the part of pension funds. An exception may be the Caisse de dépôt et placement du Québec, which has recently signalled its intention to enter this market.

Canadian private financing for power projects lags

ECA Financing

The Export Development Corporation plays a critical role in enabling Canadian power sector firms to win contracts. EDC is generally perceived to be flexible and competitive in its ability to provide suitable financing mechanisms for power projects. As well, it has recently established a project finance group to deal with limited recourse projects (projects where full sovereign guarantees for political and commercial risk are not available and must be assumed by some other entity). EDC has also been known to take a proactive role by forming consortia of suppliers and financiers, from both inside and outside Canada. In fact, multinationals familiar with the major ECAs worldwide report that EDC is superior in many ways and credit it with an excellent track record.

EDC facilitates financing for Canadian overseas power projects . . .

One of the challenges faced by EDC is the extensive foreign ownership of the Canadian power equipment sector. The multinational parent company's decision as to which branch plant will supply a certain power project is often determined by the availability of domestic export financing. If the domestic ECA consistently fails to provide sufficient financing, the parent may move product lines to subsidiaries in other jurisdictions where there is stronger support or, in the worst case, close a plant altogether. In this respect, EDC's performance has a direct bearing on the growth and survival of foreign-owned subsidiaries.

. . . supports survival of foreign-owned subsidiaries in Canada

3.4 Investment

Prospects for new, greenfield investments in Canadian manufacturing capacity are limited. In the near term, technology transfer and local content requirements will continue to drive investment in the direction of developing countries. As the current overcapacity in developed countries is reduced, the sector may well seek to increase utilization rates at home rather than make new investments.

Canadian power equipment producers rely on developing-country markets

Canadian subsidiaries compete for world product mandates

The crux of the investment issue for the electric power equipment and services sector in Canada is retention of the existing base by winning and defending product mandates. A mandate can make the difference between being a truncated extension of the parent firm's manufacturing plant and an important player with decision-making power and associated R&D activities. The most expansive variety of world product mandate gives a subsidiary exclusive responsibility for the design, manufacture and sale of a particular product line for international markets. Moreover, its technological development is focussed. A subsidiary plant with a world product mandate becomes much more difficult to shut down because it is unique within the multinational organization. Earning a product mandate requires the plant to possess superior technical know-how, skilled labour and the ability to produce high-quality goods at low cost. The sector has a number of plants with world product mandates, although the breadth of these mandates varies considerably:

- GE Canada, Lachine, Quebec, for large hydro turbines and generators
- GE Canada, Peterborough, Ontario, for large motors and nuclear fuel handling
- Babcock & Wilcox, Cambridge, Ontario, for nuclear steam generators
- Westinghouse, Hamilton, Ontario, for certain gas turbines
- Rolls Royce, Dorval, Quebec, for the Industrial Trent 800 aero-derivative gas turbine.

An alternative business strategy

There are multinationals operating in Canada that, by design, do not assign exclusive mandates to subsidiaries but instead maintain manufacturing capabilities for strategic product lines in more than one country. A particular Canadian subsidiary might produce only for the North American market while a sister plant in Europe handles Europe and Asia. These plants typically produce a wider range of product lines than do plants with world product mandates. The rationale for this corporate strategy is flexibility, which is perceived to be more valuable than economies of scale. Moreover, having plants in multiple jurisdictions allows a multinational to access more than one ECA for competitive financing, whereas a multinational that has awarded a world product mandate to a plant is dependent on the export credit agency where that plant is located.

There is therefore little point in focussing on world product mandates where this is inconsistent with a company's business strategy. The pursuit of product mandates, where feasible, must nevertheless be a priority for both government and industry.

3.5 Human Resources

Slow growth gives rise to depletion of skills . . .

Historically, the sector has benefited from skilled and experienced labour and relatively good labour/management relations. In the past decade, however, slow economic growth, technological change and rationalization have resulted in declining employment, a lack of new hiring, an aging manufacturing work force, a shift in labour requirements and the appearance of skill gaps in some areas. Downsizing may have obscured the depletion of human capital and the consequent need for a human resources strategy.

. . . leading to inadequate resources

The educational level of blue collar employees is low, with only about half having attained high school graduation. There are gaps in basic literacy and numeracy skills, both necessary foundations for higher technical learning. With employment in this sector, as in many manufacturing sectors shifting to occupations demanding superior technical qualifications, the present skill sets may well prove to be inadequate, especially in light of the rate of technological innovation that the industry is expected to experience.

Training options remain controversial . . .

How are firms going to achieve the flexibility and agility that they will need in an increasingly competitive marketplace? How are workers going to achieve lifetime employability, given that they will no longer enjoy lifetime employment, at least with a single company? Part of the answer to both questions lies in training, but there is disagreement over the kind of training that should be offered.

. . . broadly based versus specialized . . .

Generally speaking, the fear that investment in broadly based training will be wasted if employees are enticed away by competitors causes firms to emphasize job-specific training or even, when new skills are required, to hire rather than train. This approach is justified on the basis that making entry-level employees productive requires a great deal of specialized preparation, because the college programs from which they come are too general. Such an investment might be seen as excessive if the skills can be purchased "off the shelf." Opponents of this view contend that broadly based training programs are vitally important because only the recipients of such programs will be able to move fairly easily from one job to another over the course of their earning years.

. . . bottom line versus job security

To some degree, this debate divides employers, whose attention is focussed on their bottom line, and unions, who are concerned about their members' job security. In Ontario, however, companies and unions have been jointly tackling human resources issues in the Sectoral Skills Council of the Electrical/Electronics Manufacturing Industry, a highly useful initiative.

Management/ "people" skills complement technical skills

The skill requirements for engineering/white collar employees in the sector are also changing. In the past, firms developed skill sets appropriate to the technical requirements of electric power projects. Nowadays, professional employees must supplement these skills with, for example, knowledge of risk analysis, risk management and innovative structures of project financing. Moreover, although there is no shortage of skilled engineers and technologists, they frequently lack the "soft skills" required, such as report writing and presentation, communication, negotiation, teamwork and conflict resolution.

Permanent staff falls, along with incentive to invest in training for contract staff

Downsizing, coupled with a concern for reducing salary and wage budgets, has impacted hiring practices in addition to employment levels. Firms show an increasing tendency to employ a small core of permanent white collar staff, supplemented for specific projects by contract employees with special knowledge. An unfortunate concomitant of this practice is that there is little incentive to invest in the skills development of the latter group. Unless contract employees are able to acquire and sharpen professional aptitudes on their own, an unlikely prospect in most cases, this lack of investment in training will reduce the flexibility of the sector's white collar work force.

3.6 Environmental Protection

Power generation threatens environment in many ways

The electric power generation industry has an undoubted impact on the environment. The burning of fossil fuels, much of it for the generation of electricity, is one of the leading sources of human-related greenhouse gas emissions, particularly carbon dioxide, which are believed to affect climate change. Nitrogen oxides, which contribute to smog, sulphur dioxide, which returns to earth in the form of acid rain, particulates that hamper visibility and heavy metals that harm breathing are other undesirable by-products. Because fossil fuels are expected to dominate global energy supply in the short to medium term, primarily as a result of the booming energy demand in developing countries, global environmental problems threaten to become more serious. Environmental impacts are not solely attributable to the burning of fossil fuels, as evidenced by the ecosystem effects of new hydro-electricity developments and the issue of the safe disposal of spent nuclear fuel.

Technologies that safeguard environment offer scope for industry development . . .

Given its central role in the drive for protection of the environment, the industry's initiatives provide cause for encouragement. Considerable strides have been made in improving efficiencies in power generation. The utilities' environmental awareness is evidenced by the CEA's Environmental Commitment and Responsibility Program, intended to improve the environmental performance of the electric utility members and consequently enhance their credibility with their constituents. According to the Program's Declaration of Principles, the electric utility

members commit themselves to be more efficient in their use of resources (and to promote renewable energy technologies and new energy-efficient technologies) as well as to reduce the adverse environmental impact of their business.

. . . if sector rises to the challenge

The electric power equipment and services sector, as the supplier of technology to the electric power industry, is going to feel the effects of any racheting up of the priority attached to environmental protection. The sector may wish to be more engaged in the environmental debate in order to influence the type of action that will be taken by government, nationally and internationally, by the electric power generation industry or by both working together to address the issues. The range of possible actions includes voluntary, mandatory and market-driven approaches.

Voluntary measures spearhead setting limits to greenhouse gas emissions . . .

To date, actions regarding greenhouse gas emissions have been chiefly in the form of voluntary measures. Canada has undertaken the National Action Program on Climate Change and has launched the Voluntary Challenge and Registry Program, inviting companies to limit their emissions. In 1995, the CEA entered into a Memorandum of Understanding with Natural Resources Canada, committing the CEA to work with Natural Resources Canada to develop and promote the Voluntary Challenge and Registry program. Both parties undertook to work toward limiting greenhouse gas emissions and at the same time maintain the competitiveness of the industry.

. . . could be replaced by regulations and penalties if they fail . . .

The possibility cannot be dismissed that, if voluntary emission reduction commitments are unfulfilled, other, less flexible measures may be imposed by governments. An argument for more rigorous enforcement of environmental standards is that, in addition to curbing pollution, it would create a market for leading-edge technologies. The example of some European countries where stringent requirements have been imposed is often used to bolster this argument.

. . . or by emissions trading and credits to encourage reductions where costs are lowest

A third approach, consonant with letting market signals determine company strategy, would be structuring incentives for improved performance, in the form of emissions trading and credits for emissions reductions. Companies in jurisdictions where abatement costs are relatively high would be able to offset emissions by purchasing other companies' allowances or by undertaking projects that reduce pollution in jurisdictions where abatement costs are low. The monitoring of trading and joint implementation programs presents complications, but such programs promise to provide companies with the flexibility of being able to implement emissions reductions when and where it is cheapest to do so.

A combination of more rigorous enforcement of environmental standards and incentives for improved performance is represented by the Kyoto Protocol recently adopted by the Third Conference of the Parties to the United Nations Framework Convention on Climate Change. By virtue of the Protocol, Canada is committed to a legally binding reduction in all greenhouse gases of 6 percent by the period 2008–12. At the same time, the Protocol includes several mechanisms that give countries flexibility in meeting their national emissions targets. These include international trade in credits for emissions reductions and credits from projects implemented jointly, whether in developed or developing countries.

Sustainable development may enhance competitiveness, not limit it

An effective response to the challenge of environmental protection should be viewed from the perspective of business strategy. The relationship between the goal of sustainable development, which integrates environmental protection with economic and social progress, and the competitiveness of the electric power equipment and services sector is a complex one. Taking effective action toward this goal could well enhance, rather than detract from, competitiveness. Measures to advance energy efficiency and energy conservation respond to the need for utilities to curb operating costs and avoid expensive capacity additions. Moreover, meeting a likely increase in customer demand for "cleaner" forms of energy will take the same foresight and adeptness needed to capitalize on any business opportunity.

4 GROWTH PROSPECTS FOR THE SECTOR

The electric power equipment and services sector must cope with the demands of present-day markets at the same time as it adjusts to radical changes in the electric power industry. Manufacturers and consulting engineers have set their strategic direction for the short term. They are addressing very different continental and overseas markets, devoting primary attention to the latter. Success is by no means assured but the sector is capable of mobilizing considerable strengths. Far more difficult is the task of formulating strategy for the medium and longer term. Hanging over the sector is the question of how its ownership structure will evolve and how that will affect the manufacturing base in Canada.

Producers juggle current challenges with long-term changes

4.1 Demand Outlook

The North American Market

In North America, the sector is facing an impending increase in competition among electric utilities, a greater emphasis on energy conservation, possibly more demanding environmental standards and a period of surplus capacity with demand well below the levels of the early part of the decade. In both Canada and the United States, near-term expected growth rates in electricity demand are less than 2 percent a year. The capacity utilization rates of Canadian power plants are, generally speaking, satisfactory, with a reserve of installed capacity for the whole country that is 21 percent over peak load. (The picture in Ontario, however, will have changed as a result of the temporary closing of seven nuclear plants by Ontario Hydro, announced in August 1997.) The prospect of competition in energy supply and customer insistence on cheaper electricity are already motivating utilities to refrain from major investments in new plant and equipment and to use existing capacity more efficiently.

Increased competition, falling demand curtail investment in new plant and equipment

In addition to these factors, the major power sources are viewed as suffering from serious disadvantages. The combustion of fossil fuels accounts for substantial emissions of greenhouse gases. The scope for large hydro developments is limited by site availability and the huge capital outlays needed to build them. Hydro capacity may be augmented by additional pump storage. Nuclear power is even less likely to experience any growth. Since the mid-1970s, U.S. authorities have cancelled nuclear construction projects, and no new nuclear reactors have been ordered. There is unlikely to be a market for nuclear plants in Canada and the United States (or Europe) for at least 15 years. Indeed, Canada's nuclear companies are diversifying in response to the uncertainties overhanging nuclear power. (However, B&W's Cambridge, Ontario, plant has been notably successful in gaining a large part of the U.S. market for replacement nuclear steam generators.)

Current technologies have very limited scope for sector growth

The RMU Market

Future options for Canadian suppliers are rehabilitation or replacement of aging domestic equipment . . .

Almost two thirds of all U.S. utility generating facilities are 20 years old, and nearly one third are at or near the end of their expected economic life. An estimated 34 gigawatts of nuclear capacity in the U.S. will require rehabilitation between 2000 and 2015. In Canada, an age analysis indicates that 50 percent of the installed thermal capacity is scheduled for decommissioning between now and the year 2020, which translates into a potential demand of $25 billion for capital equipment. Whether aging plants will be refurbished, replaced or taken out of service altogether will depend on economic factors as well as the availability of new technologies. Refurbishment, which can lead to substantial improvements in performance and compatibility with environmental standards, does appear to be an attractive option, depending on the speed and efficiency that can be shown by the equipment suppliers. Canadian specialization in RMU (renovate, modernize, upgrade) practices could well result in increased exports, although this business will not in itself come close to sustaining existing operations.

The Overseas Market

. . . and steady growth in power demand in Asia, Latin America

Taken overall, the world market appears to be growing steadily, due to demand in emerging markets, particularly those of Asia and Latin America. The World Bank estimates that Asia will require additional generating capacity of 2 000 megawatts each month, which translates into an annual investment of US$35 billion for the next 10 years. The number-one potential market for new power over the next five years will be China, with planned capacity additions of 75 000 megawatts, followed by India with 57 000 megawatts. The tremendous increase in generating capacity will create a corresponding requirement for transmission, distribution and power systems equipment as well as environmental control systems.

Opportunities lie in coal-fired boilers, hydro and nuclear generation

In qualitative terms, the demand fits well with the Canadian sector's capability. The largest potential in Asia is for coal-fired units. China, where 80 percent of the power plants are coal-fired, now is by far the most important potential market for international boiler manufacturers. There is also a significant requirement for hydro power in the emerging markets. Large reserves of exploitable water power resources exist in Central and South America, notably Brazil, Colombia, Venezuela and Chile. Even larger is the untapped potential in Asia; for example, China has 150–200 gigawatts and India has 75 gigawatts. China's Three Gorges project alone will account for 10 gigawatts. Moreover, gas supplies are coming on stream in Malaysia, Thailand, the Philippines and Indonesia. Nuclear facilities are also in demand, which accounts for the priority that AECL's marketing plan accords to China, the Republic of Korea, Indonesia, Thailand, the Philippines and Vietnam.

4.2 The Competitiveness Challenge

Developing-country markets offer compensation for shrinking domestic demand for equipment and services

The major Canadian electric power equipment and services companies by no means constitute a monolith, but they are guided by a single strategic objective: to gain and defend a share of the market in developing countries. This is the only way that most of them can avoid having to shed even more production capacity. Other potential markets, at least as far as the equipment manufacturers are concerned, are precluded by a range of considerations: the sector does not possess the matching capability (as in the case of U.S. demand for wind and solar power installations); standards issues arise in the case of commodity exports (Africa and the Middle East use European standards); market barriers are impenetrable (generally true of the European market); or multinationals have allocated those markets to other subsidiaries.

Canadian suppliers benefit from favourable labour costs . . .

The leading Canadian equipment suppliers are technically highly competent in their fields of specialization, employ an experienced labour force, can draw on the expertise and contacts of their parent companies, and enjoy solid international reputations. Extrapolating from unit labour costs and average compensation figures for manufacturing as a whole, the sector's costs compare favourably with those of Canada's major trading partners. The most readily available information is the series of unit labour cost and compensation comparisons compiled by the U.S. Department of Labor's Bureau of Labor Statistics. Comparison, on a U.S.-dollar basis, of hourly compensation costs in manufacturing in Canada and the other G-7 countries for 1989 to 1994 shows that U.S. rates, which were below Canadian in the late 1980s and early 1990s, have moved above them. French and Japanese rates have followed a similar trend. Rates in the U.K. are still below Canadian rates but are higher than they were in the late 1980s and early 1990s.

. . . which give advantage in making labour-intensive products

The Canadian firms also benefit from the fact that their capital assets are largely depreciated. They are thus internationally competitive in products that are relatively labour-intensive and require specialized or custom design as well as niche marketing expertise. Moreover, they know how to operate in the market and have demonstrated the ability to form consortia with a broad range of suppliers, trading companies and consulting engineering firms.

Service providers facing booming world market

Canada's consulting engineers and engineering contractors too confront a vibrant world market. Total billings for work attributable to electric power infrastructure have grown substantially since 1989, according to *Engineering News Record*, a major U.S. industrial journal. Of the 200 leading design firms in the world, those delivering power services had total billings of US$294 million in 1989, which expanded to US$3.3 billion in 1995, an increase of 1 008 percent. ENR defines power services to include thermal and hydro-electric power plants, waste-to-energy plants, transmission lines, substations and co-generation plants.

Management expertise and financial strength compensate for smaller size of Canadian service providers

At the same time, notwithstanding the opportunities open to niche players, design services are highly concentrated, with the top 10 firms in electric power services accounting for about US$1.7 billion of total billings in 1995. Most of these firms are located in the U.S. A critical mass of skills is important in the growing private power market where turnkey projects are typically implemented by international consortia. The largest Canadian firms are not in the first rank as far as size is concerned, but they are in a position to compete for the larger and more profitable projects by virtue of their management expertise and their financial strength.

Financial performance of major suppliers varies widely

The overseas market can be volatile, as reflected in the recent financial performance of some of the major integrated global suppliers. After dismal results in 1995, three of the six integrated manufacturers — General Electric, Siemens and Mitsubishi Heavy Industries— increased their profits from power generation considerably in 1996. GEC Alsthom's profits were reportedly flat, ABB's were lower than in the year before, and Westinghouse reported a loss. Projects are awarded on the basis of tough bidding competitions, prices have fallen and profit margins are slim. Equipment and service providers incur increased risk with limited recourse project financing and are frequently faced with the need to invest their own funds and secure funds from other investors. There are serious deficiencies in legal and regulatory systems and in the treatment accorded foreign investors.

Manufacturers and consulting engineers expand areas of cooperation

To be able to cope more successfully with the exigencies of the new environment, the manufacturers and consulting engineers have accelerated their cooperative activities and their cooperation with government. Instances of this cooperation range from participation in Team Canada missions to carefully coordinated marketing plans and considerable information sharing. A sector that has been domestically oriented for many decades is being converted into an exporter.

Sector has scope for following up on recent gains in overseas markets

How effectively is the sector mobilizing its resources to expand the bridgehead it has already gained in the developing countries' market, and how energetically are its initiatives being supported or complemented by government? In the areas of market reform, mandates and export strategy, it would be possible to build on efforts that have been made to improve sector performance. These areas should be the focus of further analysis and debate leading to the development of a *Framework for Action*, which is planned to be the second part of this *Sector Competitiveness Framework*.

The Importance of the Domestic Market

Canadian market restructuring will shape competitiveness abroad

The manner in which the Canadian electricity market is restructured and the speed with which this is accomplished will be significant determinants of the sector's competitiveness in export markets. This is the lesson that can be learned from the experiences of U.S. and European manufacturers. Having to respond quickly and flexibly to new demands from a competitive

domestic marketplace will strengthen the ability of Canadian exporters to succeed in an international environment where competition is already intense and where practices are evolving rapidly. Competition at home will also strengthen the technological capability of the sector by stimulating the adoption or incubation of new technologies.

More Canadian power developers would benefit the sector

The major developers in the international power market typically got their start and gained their expertise in an active domestic market. Canada has a few IPP developers, such as Transalta Energy Corp., Westcoast Energy and Northland Power, with others beginning to emerge. The domestic market has not, however, favoured their growth. The deregulation of the electricity market must be further advanced for Canadian developers to acquire the skills and contacts that will make them competitors of global players such as Enron and Mission Energy, which emerged from the deregulated energy markets of the U.S. To be sure, when it comes to packaging bids, even developers headquartered in Canada will select suppliers on the basis of business considerations rather than nationality. They will, however, possess an intimate knowledge of the Canadian capability, which should benefit the sector.

Mandates

Companies and government can work together to help win product mandates . . .

The goal of gaining, sustaining and expanding the scope of product mandates, defined broadly in both geographic and functional terms, affords an opportunity for close collaboration between industry and government. Research funded by Industry Canada (Julian Birkinshaw, *World Mandate Strategies for Canadian Subsidiaries*, Working Paper 9, Ottawa: Industry Canada, March 1996) demonstrates that the achievement of this goal depends greatly on the initiative shown by subsidiaries of multinational corporations. At the same time, these companies can make more headway with their global headquarters by pointing to additional resources that can be used to bolster project bids. EDC plays the role of advocate for the sector by keeping head offices of multinationals informed of the range and sophistication of its services. Exporters can also call on CIDA's assistance to undertake feasibility studies and make use of the services of the Canadian Commercial Corporation (CCC), a Crown corporation that assists Canadian companies contracting abroad. Through CCC's involvement, Canadian exporters gain credibility, and the possibility of sole-source contracting is enhanced.

Export Strategy

. . . but firms also must prepare for continuous innovation in financing

How resources are mobilized behind bids that include substantial Canadian content is an issue that must be kept under constant review because the circumstances are always changing. The pressure on firms to devise new and more innovative financing packages is relentless. Companies in the sector recognize the importance of increasing the supply of financing available to them and are stepping up efforts to this end. More could be done to attract Canadian

sources of private finance, including banks and investment and pension funds, to complement financing provided by EDC. This would permit Canadian bidders to offer a comprehensive package, which is a selling point in purchasers' eyes.

Strategic alliances with key international players help win bids

The chances of winning a project are bolstered by strategic alliances and partnerships with companies that, whether on account of reputation, capability or contacts, have the inside track on major projects and, most important, bring with them financing from their own national ECAs. Canadian companies have shown themselves to be highly adept in strategic partnering, which is one reason that they have won bid competitions abroad. Equipment suppliers and consulting engineering firms in the sector have a powerful incentive to cooperate. Both groups need to bolster the knowledge that international players have of the Canadian capability and to cement relationships with global developers, engineering firms and banks known for their ability to spearhead successful project bids.

A Longer View

Business strategies must anticipate rather than ride trends

A strategy that focusses on vibrant emerging markets places a premium on familiar technology put to the service of large-scale power development. If the electric power equipment and services sector can mobilize its resources effectively, it can sustain its already reduced capacity and work force for a decade or longer. The danger inherent in such a strategy, however, is that it could be a way to postpone adapting new technologies and experimenting with new forms of service to the customer. At the same time, it may yield diminishing returns, as manufacturers in the developing countries gain larger and larger shares of those markets for themselves. Thus, decision makers must look beyond the sector's current emphasis on exporting to underlying trends in the production, marketing and selling of energy. Equipment and service providers will have to examine whether their business strategies are effective and whether their product mixes match demand in the markets closer to home where there is intense competition for energy services.

4.3 Future Opportunities

Changes in technology bolster competition . . .

The future of the equipment and services sector is being shaped by the twin forces of competition and technology. Competition is driving executives to look beyond their own organizations to capture capabilities, resources and new opportunities for customer service that exist largely because of technological advances. The utilities and equipment manufacturers are, for example, reaching outside the traditional boundaries of the power sector to computer software and power electronics to enhance their capability to transmit power directly to distant purchasers.

. . . and vice versa

Competition necessitates not only serving the market better but also expanding the boundaries of the market. Technology is enabling this to happen. Canadian utilities now are devoting

considerable effort to the development of electrotechnologies, which are finding a wide range of applications in such fields as transportation, environmental protection and resource processing. Unconventional uses of electricity are being explored, such as the protection of infrastructure against corrosion. The utilities and their suppliers share a common interest in increasing electricity's share of total energy consumption and a motive to cooperate more closely.

New risk profiles emerge

Competitive and technological forces are also giving rise to a much livelier appreciation of risk. Take, for example, the choice of generation systems, which carries greater risks in a competitive than in a regulated environment. It is by no means certain that distributed generation will carry the day, though gas turbines are becoming more efficient and photovoltaics and fuel cells are finding applications, particularly in remote locations. Technology will reduce the costs of operating existing plant, and coal and nuclear power will remain tough competitors. Rational choice will be governed by the shifting variables of fuel prices, cost of capital, transmission costs, environmental impacts and market opportunities.

In the new environment traditional roles are blurred

Competition and technology thus set up incentives to look for allies and even enter into mergers. This is a way of acquiring greater combinations of skills, sharing development costs and securing access to previously untapped markets. There has already been some blurring of roles: utilities that join in consortia to build power plants abroad; equipment suppliers that have become adept in project management; and engineering contractors that take equity positions. Now ever closer links are being forged between the planning and management of electric power projects, the generation, transmission, distribution and retailing of electricity, the manufacture of equipment for these activities, R&D aimed at their enhancement and even some of the applications of electricity.

Shifting alignments of parent corporations jeopardize Canadian suppliers

How will these forces shape the electric power equipment and services sector? Answering this question requires distinguishing between developments internal to the sector and those that originate outside it. Within the sector, the major Canadian manufacturers are already feeling the impact of shifting alignments on the part of their parent corporations. The more manoeuvring room that they can win within their organizations, the more they can assist their own survival. Multinational owners may also have their own reasons for wanting to maintain a Canadian supply capability. Nevertheless, neither factor can serve as sufficient protection for the sector. It will be extremely difficult to buy immunity from the danger that, after the temporary reprieve afforded by the opportunity to sell into export markets, the multinationals seek to wring the last bit of revenue out of aging capital and buildings and, rather than retooling and reinvesting, consolidate their operations close to a greater concentration of customers, retaining only sales offices in Canada.

New global deal makers are emerging . . .

Meanwhile, outside the sector, there are new alignments of energy producers. Judging by the mergers of gas companies with producers and distributors of electricity that have recently taken place, it is seen as an advantage to be an energy company offering full energy services and competing on a "BTU for BTU" basis. Corporate realignments are, in fact, going one step further with the emergence of global power companies, many of them loosely, if at all, linked to the old utilities and exhibiting characteristics of a very different culture. These companies are not primarily focussed on building or operating power plants, although their purposes may be served by such activities, but on deal making, buying and selling assets anywhere in the world. The international power business is rapidly being concentrated in their hands.

. . . with whom equipment and services suppliers will have to contend

How will the Canadian equipment and services suppliers position themselves vis-à-vis these companies? This is the central challenge confronting the sector. It is likely that the energy conglomerates themselves will want to avoid allying with specific suppliers. They will prefer instead to encourage aggressive competition in order to get the equipment most appropriate to their needs at the best price. Having to survive in a market dominated by skilled entrepreneurs and deal makers, rather than by former utilities struggling to reorient themselves to restructuring, is going to enhance the competitive pressures that the equipment and services suppliers are already experiencing.

The sector's strategy must be to come up with energy solutions . . .

There is nevertheless an opportunity here for imaginative business strategy aimed at forming competitive alliances that enable synergy, a wide range of cooperative activities and joint access to government support, and may well extend as far as ownership links. Customers will be looking for the most comprehensive energy solutions achievable, which will require pooling the capabilities of equipment and services suppliers. The skills, adeptness and contacts of companies in the sector will influence whether they can win business from the corporate actors now emerging.

. . . going as far as to marry mainstream and emerging technologies

The development of more comprehensive packages of equipment and services could include marrying mainstream and emerging technologies and anticipating future markets by pulling into partnership SME niche players with products that are more environmentally friendly and smaller, require less capital outlay and, being modular, offer greater flexibility than the components of present-day electric power systems. If Canadian electric power equipment and services companies manage their alliances to make the most of such opportunities, they have a good chance of gaining a long-term stake in the international power industry.

4.4 The Bottom Line

The transformation that the electric power industry is undergoing in the developed world is occurring more gradually in the emerging markets as well. It will demand major adjustments by the participants. They will need to have a deeper understanding of what markets are demanding and the flexibility to cope with rapidly changing short-run requirements, and they will have to make a determined effort to seize the possibilities of a confusing array of new technologies.

The long-term challenge is the transformation of the electric power industry

It will be impossible to survive in the energy business of the next century unless the participants share in an expansive vision of its purpose and work with government and other stakeholders toward making that vision a reality. The vision should highlight the role of electricity in satisfying customer wants and achieving sustainable development and global prosperity. Practical measures that position the sector to help realize these goals, which it should share with the entire electric power industry, will constitute a *Framework for Action*. This present document seeks to assist the development of the *Framework* by providing a frank appreciation of the sector's current circumstances and prospects.

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Annex A
CANADIAN FIRMS, BY SUBSECTOR

There are about 20 dominant firms in the Canadian electric power equipment and services sector. Table A-1 lists some of the larger ones by subsector.

Table A-1. Larger Firms, by Subsector

Power Boilers	
Babcock & Wilcox (Cambridge ON)	• Canada's largest manufacturer of fossil and nuclear steam generation systems; environmental emissions technology and services for electric power and industrial customers
Turbines/Generators	
GE Canada Inc. (Lachine QC and Peterborough ON)	• Lachine plant: world centre for the development and production of hydro-electric turbines and generators; hydraulics R&D • Peterborough plant: world leader in large rotating machine technology (R&D); builds generators up to 350 cm (140 inches) in diameter
GEC Alsthom Energies Inc. (Tracy QC)	• produces large hydro turbines; integrated turbine/generator sets
Westinghouse Canada (Hamilton ON)	• world product mandates for gas turbine parts and services; mature gas turbine parts and services; small steam turbines less than 100 megawatts; hydro generator services
Transformers	
Asea Brown Boveri Canada Inc. (Varennes QC and Guelph ON)	• a principal manufacturer of power transformers
Ferranti-Packard Transformers Ltd. (St. Catharines ON and Trois-Rivières QC)	• a principal manufacturer of power transformers
Haefely Trench (Scarborough ON)	• a leading supplier worldwide of high-voltage instrument transformers
Switchgear and Controls	
CAE Electronics Ltd. (Saint-Laurent QC)	• a leader in control systems and simulators
Schneider Canada Inc. (Brampton ON)	• manufactures medium- and low-voltage switchgear, panel boards, motor control centres, switchboards

Table A-1. Larger Firms, by Subsector *(cont'd)*

Wire and Cable	
Alcan Aluminium Ltd. (Bracebridge ON)	• manufactures low-voltage transmission cable of 600–1 000 volts, service cables, tack cables
Alcatel Canada Wire Inc. (Vanier QC and Weyburn SK)	• a leading North American electrical wire and cable manufacturer, providing a full range of products for various sectors
Phillips Cables Ltd. (Scarborough ON)	• designs, engineers and manufactures wire and cable for high-voltage electrical transmission
Pirelli Cables Inc. (Saint-Jean-sur-Richelieu QC)	• manufactures low-, medium- and high-voltage power cables
Services	
Acres International (Niagara Falls ON)	• consulting engineering and management services in the power and energy sectors for hydro-electric developments; conventional thermal and co-generation plants; transmission lines; substations and distribution systems; power systems; generation planning
Atomic Energy of Canada Limited (Mississauga ON and Chalk River ON)	• R&D and engineering services in support of CANDU nuclear reactors
AGRA Industries Limited (Toronto ON)	• experts in energy fuels; coal processing/handling/transportation; electric power generation, transmission and distribution systems
SNC-Lavalin (Montreal QC)	• consultants in electric power generation, transmission and distribution systems, district heating, co-generation