THE CANADIAN ELECTRONICS INDUSTRY

May 1991

INVESTMENT CANADA

INVESTISSEMENT CANADA

THE CANADIAN ELECTRONICS INDUSTRY

May 1991

The information contained in this report was prepared by the Investor Services Group. For further information please contact:

Manager, North America
Investor Services Group
Investment Canada
P. O. Box 2800
Station "D"
Ottawa, Ontario, K1P 6A5
Telephone (613) 995-7231
Fax (613) 996-2515
Telex 053-4450

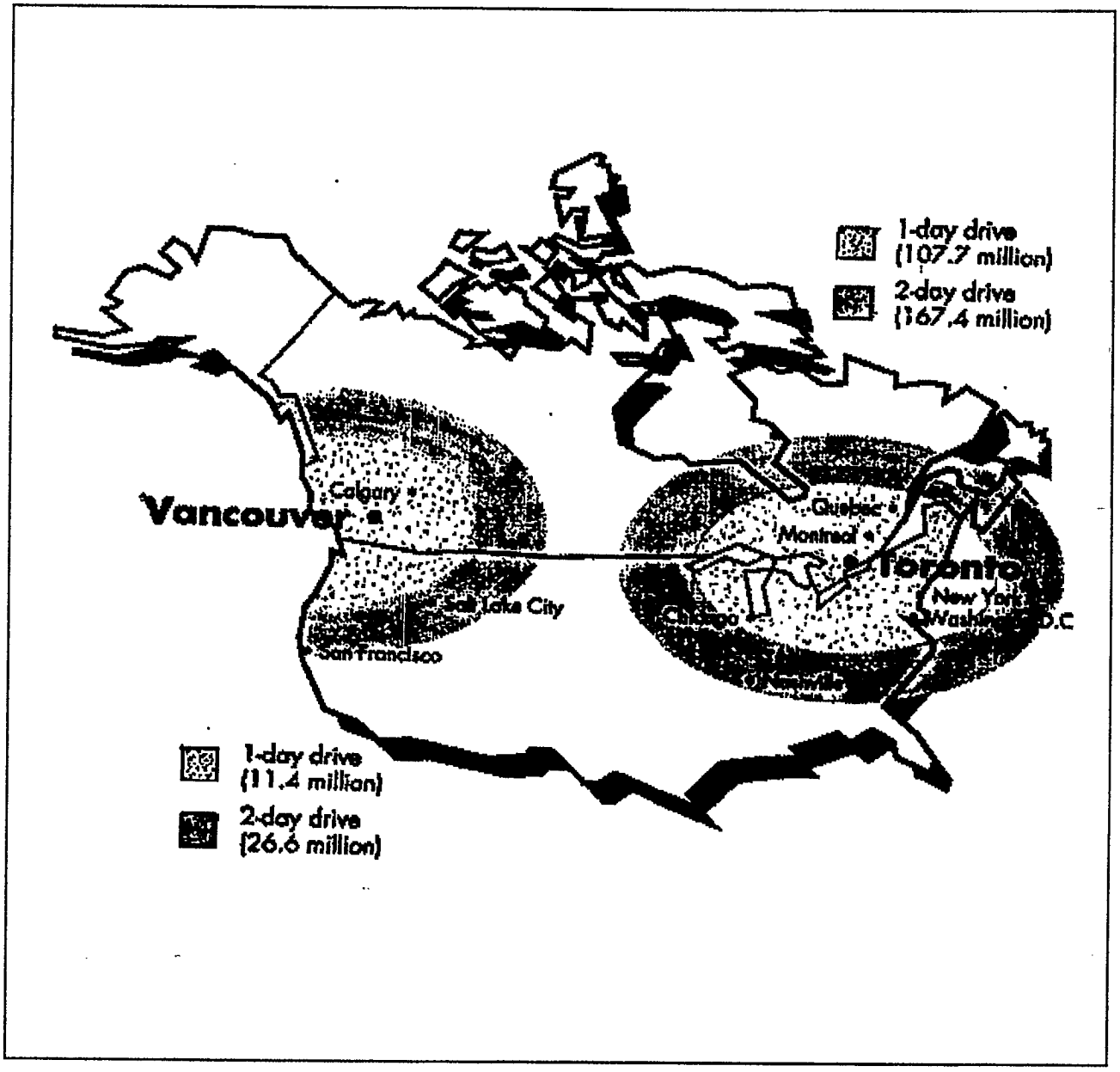
THE CANADIAN ELECTRONICS INDUSTRY

Over the past decade, increasing globalization of markets, especially in the electronics industry, has created new opportunities for expansion. Building on a strategic location in the world's largest market for electronic goods, Canadian-based electronic manufacturers have ready access to the growing European and Asian markets. To capitalize on the accelerating international demand for electronic products, Canada has constructed an investment environment that fosters and accomodates the innovation necessary to maintain an internationally competitive electronics industry by providing :

- secure access to the $300 billion North American market for electronic products;
- one of the world's best educated and stable work forces;
- a favourable environment for manufacturing and research and development;
- an excellent transportation and communication infrastructure, facilitating business on a global basis; as well as providing,
- abundant supplies of raw materials, and secure supplies of low cost energy and water.

SECURE ACCESS TO THE WORLD'S LARGEST ELECTRONICS MARKET

With 275 million people spending approximately $300 billion on electronic products in 1989, North America is the world's largest and most lucrative market. More than 150 million live within a two day drive of the industrial cities of Central Canada. Within easy reach of major Canadian cities are the large U.S. metropolitan centres of New York, Boston, Detroit, Chicago, Washington, Minneapolis, and Seattle. (See Figure 1).



As a result of the introduction of the Canadian-U.S. Free Trade Agreement, links between the two trading partners have been enhanced through the removal of tariffs and enhanced personnel mobility. By 1993 the agreement will eliminate the duty on most telecommunications equipment between Canada and the United States. Tariffs on most other electronics goods, which averaged between 3% and 6% in the past, have already been removed. In addition, the FTA's temporary access provisions reduce impediments for temporary entry, so that electronics companies are able to send sales, service and support staffs across the border more freely.

Canadian electronics companies have recognized for many years that the Canadian market is not large enough to justify the economies of scale that would make them globally competitive; therefore, they chose to pursue export markets. As indicated in Figure 2, Canadian companies have significantly increased their exports to world markets since 1984. Trade in electronics goods between Canada and the U.S. totals over $12 billion. Coming north in 1989 was $8 billion in U.S. electronics exports, $506 million more than the United States exported to Japan. Going south was $4.4 billion in Canadian electronics goods, 70% of Canada's total export of electronics products.

In 1989, the first year of the F.T.A., Canada increased exports to the U.S. in the Electronic Parts and Components Industry by half a billion dollars (Cdn.), and improved its balance of trade in electronics products by $173 million. In fact, in 28 of 40 sub-classifications of the Electronic Parts and Components Industry, Canada improved their balance of trade vis a vis the U.S..

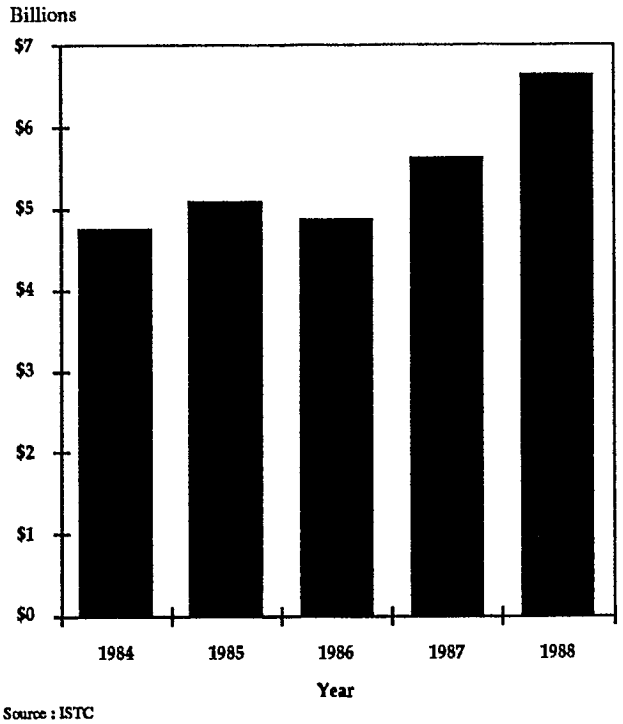
Canada's ability to compete in electronics production has been reflected by rapidly increasing capital investment in electronics manufacturing (See Figure 3). Many multi-national companies have recognized Canada's competitiveness in the electronics industry and have established manufacturing facilities in Canada. Philips N.V. produces personal computers in Canada for worldwide markets, IBM Canada augmented its investments by 26.5% to $361 million in 1989, as well as Hughes Aircraft, LSI Logic and many Japanese companies such as Mitsubishi Electronics Industries Canada Inc..

Perhaps the foremost example of Canada's ability to produce for international markets is Northern Telecom. Northern Telecom, Canada's largest electronics manufacturer, derived 67% of its $6.1 billion worldwide 1989 revenue from export sales. Northern Telecom's non-North American business increased 34% in 1989. Northern Telecom is the second largest telecommunications company in North America and the sixth largest captive chip maker in the world.

Canadian electronics producers can take advantage of the existing parts supplier networks. As outlined in Appendix 2, Canadian manufacturers can obtain parts from not only the Canadian supplier network, but can also exploit the U.S. network for production resources.

Figure 2:

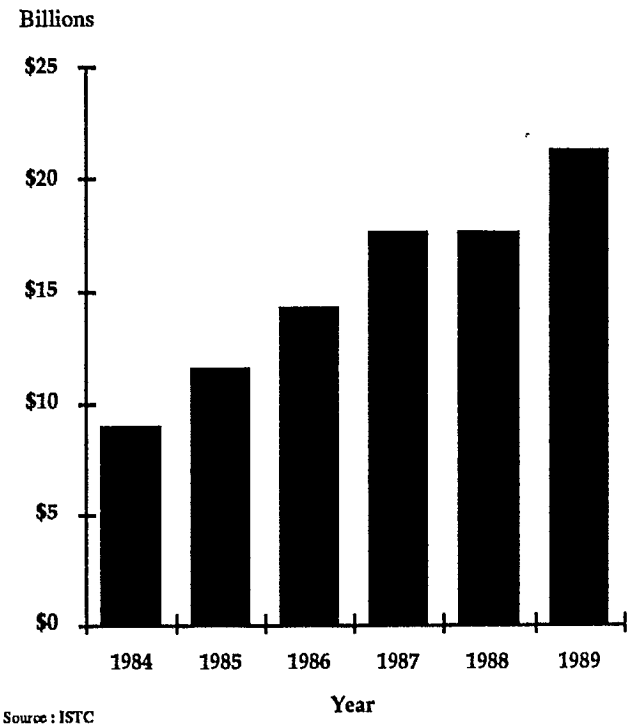
CANADIAN ELECTRONICS GOODS EXPORTS



Source : ISTC

Figure 3:

CAPITAL INVESTMENT IN MANUFACTURING



Source : ISTC

A HIGH QUALITY WORKFORCE

The high level of education and the high literacy rate in Canada permeate all aspects of operations. The Canadian workforce is well suited to more complex tasks and complex processes. Their level of training is high and is enhanced by such programs as the Canadian Jobs Skills Training Program. This program, administered by Canada Employment and Immigration, offers companies the opportunity to provide their employees with high skills training at a substantially reduced cost. As a result, Electronics producers in Canada enjoy such employment advantages as:

- a highly skilled labour force capable of adapting to new and complex production processes common in today's high technology industries;

- favourable production labour costs. The hourly compensation for workers in the "Electrical and Electronic Equipment" manufacturing sector in Canada was US$12.80 compared to the U.S. wage of US$13.97 (World Economic Forum, 1990);

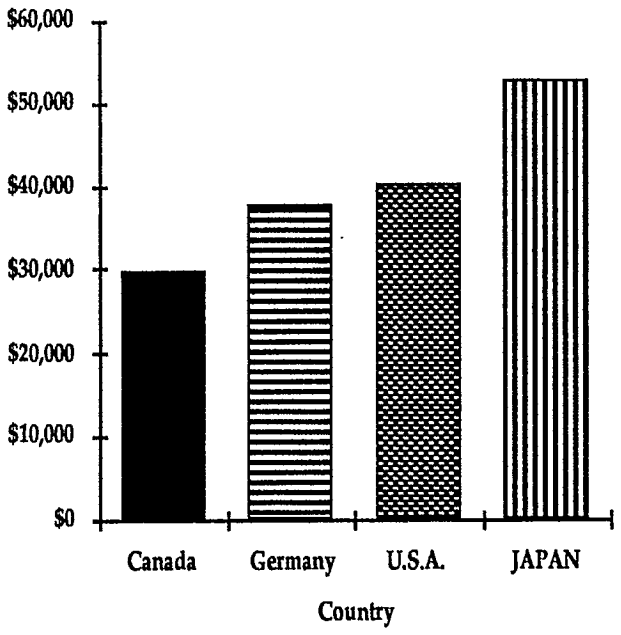
- government sponsored health care, which eliminates the need for business to provide costly medical plans such as those offered in the U.S.;

- favourable salary costs for production department managers. The average 1989 salary level for these managers in Canada of $30,000 proved to be amount one third lower than salaries in the U.S. (Figure 4).

Employment in the Canadian Telecommunications and Computer Parts Manufacturing industries has increased by 16% since 1985 to over 56,000 in 1989, when manufacturing employment increased by 6% for the second year in a row. Total employment in the electronics industry in Canada increased to 100,000 in 1989 (Figure 5). Productivity per employee also increased in 1989 by 5.8%, as measured by the value of sales per manufacturing employee.

Figure 4:

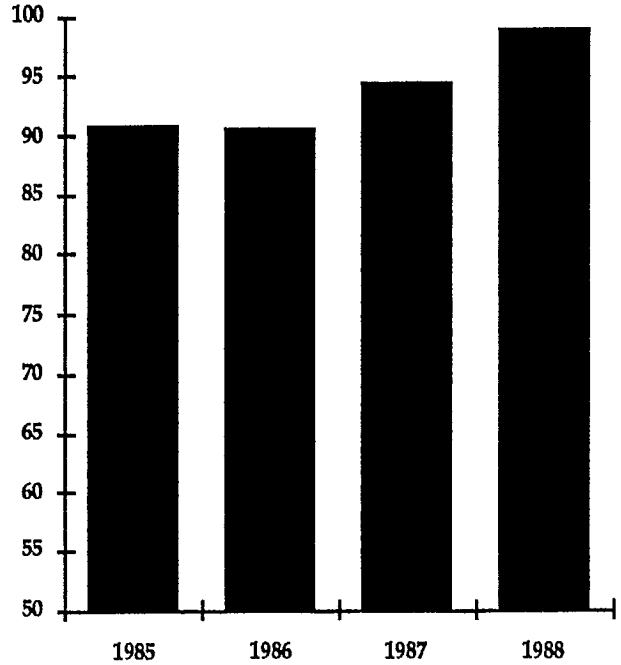
Salary Levels of Production Department Managers, 1989



Source:

Figure 5:

Employment in Electronics Manufacturing



Source:

A FAVORABLE ENVIRONMENT FOR MANUFACTURING AND RESEARCH AND DEVELOPMENT

Availability of Scientific and Engineering Personnel

Multinationals, with sophisticated R&D and manufacturing operations in Canada, offer varying reasons for locating manufacturing in the Canada, but they all agree that one of the most important advantages Canada enjoys is its pool of highly trained professional engineers, and skilled engineering technologists and technicians.

Canada has a diverse pool of engineering talent. Canadians are among the most highly educated people in the world, with approximately 25% of Canadians having graduated from a post-secondary institution, nearly half of whom are university graduates. Canada's post-secondary institutions had a total 1988-89 enrolment of 820,000 full-time students. Of these students, some 109,000 are enrolled in engineering or engineering technologies. In 1988, Canadian post secondaryschools graduated some 20,000 science, engineering and engineering technologists.

Canada has an estimated 155,000 university graduate engineers in the workforce. Of these graduates, the nation has 112,000 engineers accredited by the professional association. Among the engineers with professional accreditation, 20% are involved in project planning, 13.5% are involved in research and development and design, and 13% are involved in operations and production.

University educated engineers earned an average annual salary in 1988 of between $40,000 and $60,000 depending on their level of education (Bachelor's, Master's, or Doctorate). Among engineers who were accredited by the professional association, salaries averaged $51,000.

According to the Canadian Council of Professional Engineers, "electrical engineering enrolment surged in the 1980s, especially in the electronics area." In addition to university graduates, Canada's labour market is also supplied with engineering graduates from community colleges. Of the nearly 13,000 engineering and applied sciences graduates from community colleges in 1988, 3,290 were graduated from computer science and mathematics, 3,729 from electrical and electronic technologies, and 4,905 graduated from engineering technologies programs.

Canada's Tax Environment for Manufacturing Firms

Canada has a favourable tax environment for companies in the electronics industry. Two of the most prominent tax incentives for manufacturers are the lower income tax rate for manufacturing income and the R&D tax credit. In addition to the federal incentives, the provinces offer similar incentives to electronics producers in the form of research and development assistance and tax holidays for new corporations.

A special deduction exists to reduce federal corporate income tax rate on manufacturing income. The lower tax rate for income from manufacturing and processing activities is 23.84% as of July 1, 1991. This figure is inclusive of federal surtax, and the abatement for provincial tax.

In addition to federal income tax, the provinces and territories also levy income taxes of their own. The income tax rates vary from a low of 5.5% to 17%, and are calculated based on the federal calculations of income, with some minor modifications with the exception of Quebec which levies tax based on their own calculation of income.

Tax Credits for the Performance of Research and Development

Special tax incentives are available through both the federal and provincial governments for Research and Development in Canada. The purpose of the tax incentives is to encourage R&D in Canada. The federal government provides incentives in the form of a tax credit. The R&D tax credit is Canada's largest single incentive for R&D, with estimated annual benefits conferred to corporations stated to be over $750 million.

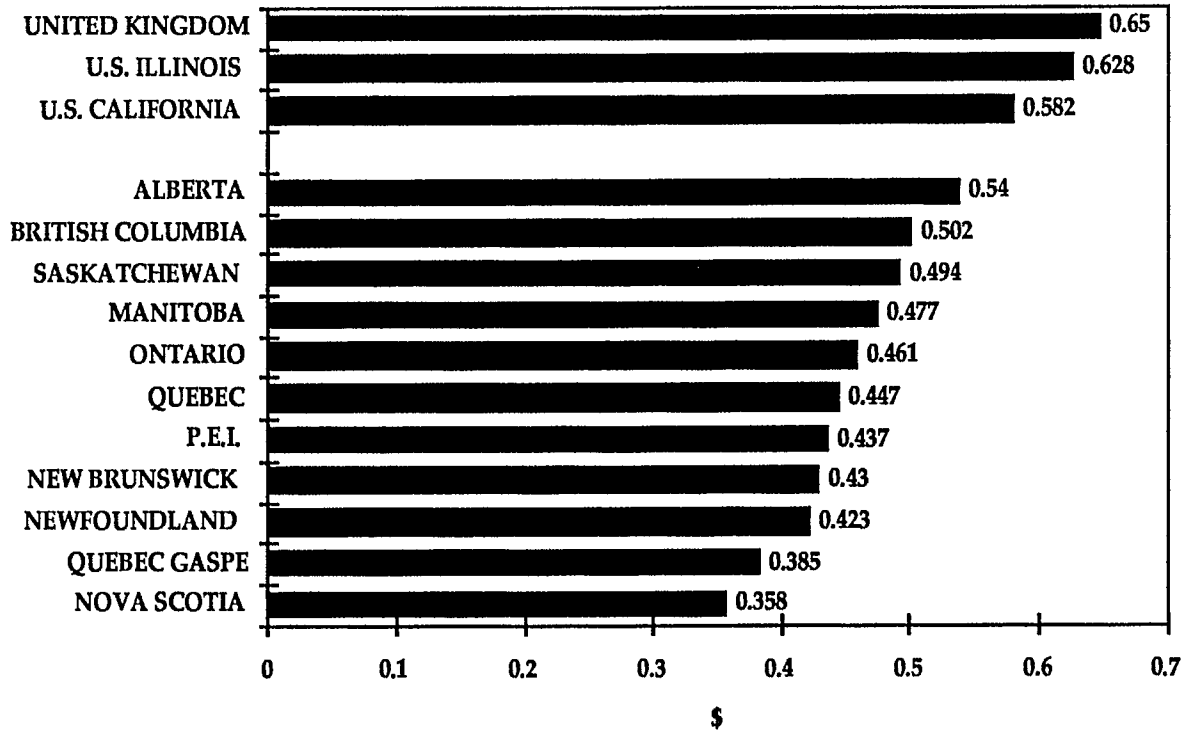
The federal R&D tax credit is available to both Canadian and non-Canadian corporations, although the rules differ somewhat. The R&D tax credit is available to corporations for all current and fixed expenditures, except buildings. The R&D expenditure can be claimed in the year incurred or accumulated indefinitely for write-off in a subsequent period, as long as the expenditure is not deducted from income in any other year.

For non-Canadian Controlled Private Corporations (Non-CCPCs), a tax credit of 20% of Research and Development costs is available. If the R&D is performed in the maritime provinces or the northern peninsula of Gaspé, it is eligible for a credit of 30%, rather than the 20% offered to non-CCPCs. Non-CCPCs can claim R&D tax credits totalling up to 75% of tax otherwise payable including the federal surtax. The cost of R&D less any R&D tax credit received can be deducted as an expense in the year incurred.

In addition to the savings in federal tax, there are tax savings to be realized at the provincial level through programs which parallel the federal program. The net result of the federal and provincial programs is to reduce the cost of $1 of R&D to between $0.358 and $0.54 depending on where the R&D is carried out (Figure 6).

Figure 6:

AFTER TAX COST OF $1 R&D



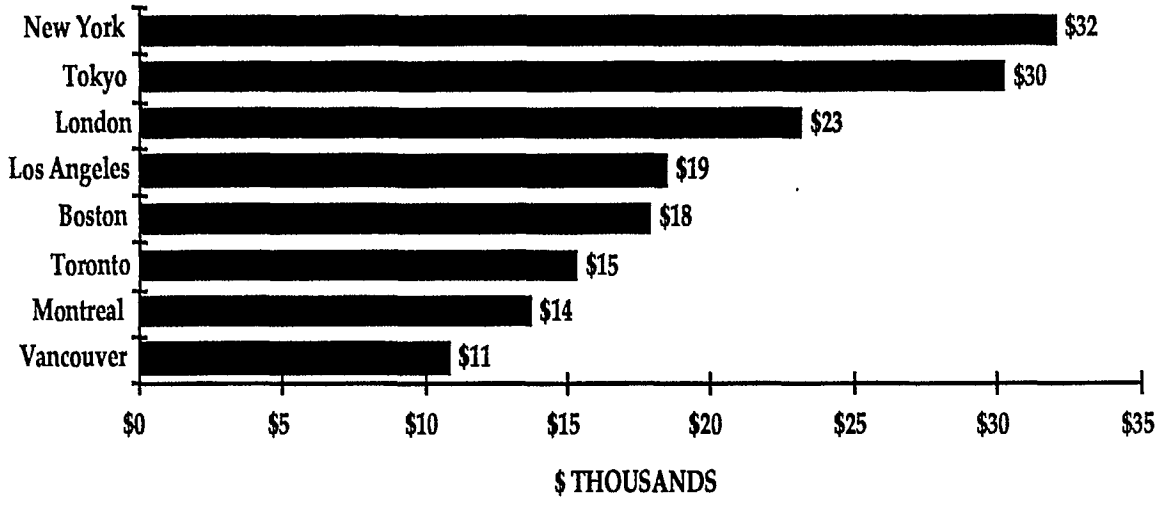
Source:

Appendices 3, 4 and 5 provide detailed examples of how the tax credit system operates in the various Canadian provinces.

LOW-COST ENERGY AND ABUNDANT NATURAL RESOURCES

Abundant and secure supplies of energy and raw materials are other components of Canada's competitive advantage. Canada has the largest supply of fresh water in the world. This vast supply of water results not only in inexpensive water for industrial and domestic use, but also provides Canada with an abundant supply of inexpensive hydro-electricity. A 1988 study revealed that the cost of electricity and natural gas in Canada aresignificantly less expensive than in other industrialized nations (Figures 7 & 8).

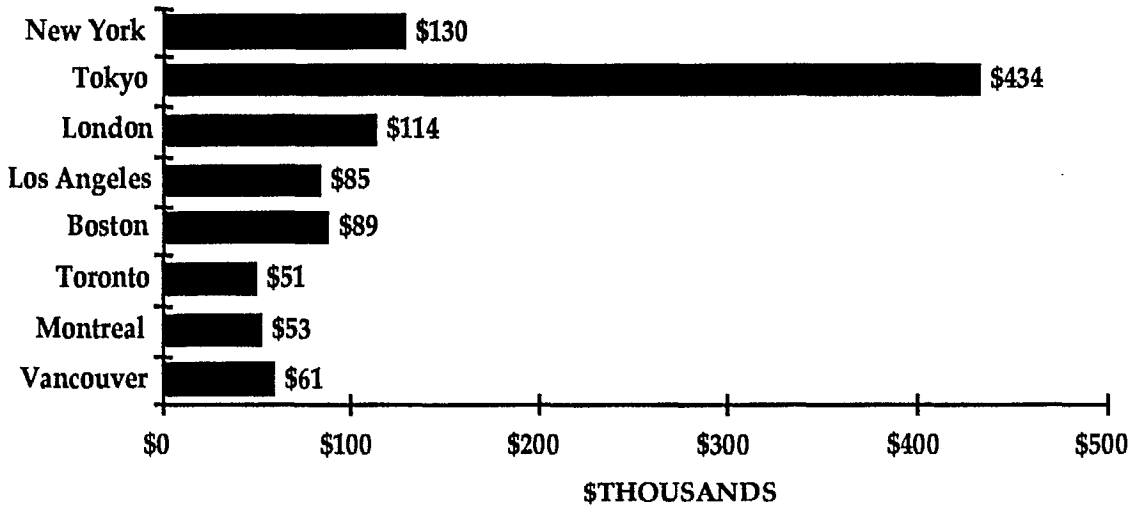
Figure 7: ELECTRICITY COSTS: AN INTERNATIONAL COMPARISON



Sources: Various Electric Utilities, 1988

In terms of other resources, Canada is one of only two G-7 countries that is self sufficient in oil supplies. Other raw materials such as minerals and semi-processed goods are also abundant in Canada. The 1990 World Competitiveness Report ranked Canada second of 23 countries in terms of its natural endowment.

Figure 8: NATURAL GAS COSTS: AN INTERNATIONAL COMPARISON



Sources: Various Gas Utilities. 1988, Cost (425,000 m3 per month).

A SUPERIOR TRANSPORTATION AND COMMUNICATIONS INFRASTRUCTURE

Canadian companies are acknowledged world leaders in the areas transportation and communications. Canada's size and export orientation has necessitated a strong transportation and communication infrastructure for conducting business on an international scale. Firms located in Canada have easy access to the entire North American market through an integrated system of highways, railways and air, sea and communication links. Canada has two transcontinental railways and more than 20 regional systems. There are over 271,000 kilometers (168,000 miles) of paved highways, some 25 major deep water ports, and in excess of 1,800 airports. The various modes of transportation are well connected and cargo can usually be switched from one mode to another without changing containers. Canada has international ocean ports serving both sides of the country, across either the Atlantic or Pacific ocean.

Canada's communications infrastructure is second to none, with high quality fibre-optic and satellite communications spanning the globe providing the highest quality telephone communications.

GOVERNMENT SUPPORT FOR HIGH TECHNOLOGY COMPANIES

The Government of Canada recognizes the need for continuous innovation in the Canadian electronics industry in order to remain internationally competitive. In addition to providing business and particularly high-technology companies with a favourable climate for doing business, the Government of Canada has developed numerous programs to foster growth in technology intensive industry. Through the establishment of targeted government programs in support of technological development, the Canadian government and industry have created a unique system of co-operation not found elsewhere in the world.

The extent and flexibility of the federal government programs which are applicable to electronics manufacturers can be seen in the chart on the opposite page. A detailed description of the most commonly used programs is provided in Appendix 1.

CONCLUSION

With annual purchases of $300 billion, North America represents the largest market for electronics products in the world. The Free Trade Agreement between the United States and Canada, enacted in 1989, opens up tariff-free access to the entire continental market from a Canadian production base. Servicing the North American market from Canadian locations is now both feasible and desirable.

Producers who locate in Canada benefit from the nation's economic and social infrastructure which includes:

- an excellent transportation and communication system;
- excellent support for the performance of research and development;
- a large pool of trained engineering professionals;
- superior education and healthcare systems;
- a large and qualified labour force;
- competitive wage levels;
- clean, well managed cities.

Canada has a strong base of internationally competitive microelectronics parts suppliers, able to supply the range of components needed to manufacture most finished electronics products. Canada's parts industry has been significantly strengthened through long term supplier relationships with several large Canadian-based manufacturers of electronic products, such as Northern Telecom, LSI Logic, IBM Canada, Philips, Mitsubishi, Matsushita, and Toshiba. The capabilities of Canada's parts suppliers have been further demonstrated through success selling into export markets.

These facts make a compelling case for choosing a Canadian location from which to serve the North American market for electronics products.

Listing of Canadian Initiatives for the Development of the Micro-Electronics Industry

PROGRAM	RESPONSIBLE DEPARTMENT
Tax Incentives :	
Research and Development Tax Credits	Revenue Canada
Financial Assistance :	
Defence Industry Productivity Program	Industry Science and Technology Canada
Industrial Research Assistance Program	National Research Council
Microelectronics and Systems Development Program	Industry Science and Technology Canada
Strategic Grants Program	National Science and Engineering Research Program
Strategic Technologies Program	Industry Science and Technology Canada
Atlantic Canada Opportunities Agency	Same (ACOA)
Western Economic Diversification	Same (WEDC)
Training Activities :	
Skills Shortages Program	Employment and Immigration Canada
Skill Investment Program	Employment and Immigration Canada
Research Manpower Program	National Science and Engineering Research Program
Technology Institutes :	
Technology Centres	Industry Science and Technology Canada
Technology Outreach Program	Industry Science and Technology Canada
Communications Research Centre	Department of Communications
Canadian Workplace Automation Research Centre	Department of Communications
Canadian Institute for Advanced Research	Same (CIAR)
National Research Council	Same (NRC)
International Initiatives in Science and Technology :	
Defence Programs and Advanced Technology Bureau	External Affairs Canada
Technology Inflow Program	External Affairs Canada
Program for Export Market Development	External Affairs Canada

Appendix 1
Federal Government Assistance for Electronics Manufacturers

Programme Name : **Strategic Technologies Program**

Eligible Projects: Financial support for industry led R&D and technology application alliances in the area of information technology. Projects must be in the pre-competitive and pre-commercial phase of development. Intended for projects which develop and apply technology necessary to :

- produce internationally competitive products,
- diversification and addition of value to products of resource based companies,
- to improve productivity and quality in manufacturing.

Eligible Costs : Salaries of scientists and engineers, analysts, programmers and technical staff; A portion of management and administrative staff salaries; materials, components and special purpose machinery and equipment; travel and communication; prototypes; training; and subcontracts.

Maximum Assistance : Up to 50% of eligible costs related directly to the project

Terms of Assistance : Non-repayable contributions

Programme Name : **Microelectronics and Systems Development Program**

Eligible Projects : Research and development work in the areas of innovative generic microelectroics components and of systems based on advanced microelectronics and information technologies including :

- The development of components such as optoelectronic devices, integrated circuits and microwave devices for use in advanced systems and subsystems.
- Projects that are based on or incorporate advanced microelectronics and information technologies that are applied in manufacturing, process or service industries.

Any taxable corporation operating in Canada can apply for funding, including manufacturing, processing or service companies with in-house systems engineering capabilities; companies specializing in systems and software development; and developers of microelectronics or specialty electronic equipment for integrated systems applications.

Maximum Assistance : 50% of eligible Research and Development costs, to a maximum of $5 million.

Terms of Assistance : Projects over $500,000 are fully repayable

Programme Name : **Western Economic Diversification Canada**

Eligible Projects : Projects are assessed in terms of their contribution to the diversification of the western economy. WD provide "last-in" funding and only where a project could not proceed without it.

Eligible Costs :

- New product development/commercialization;
- Plant establishment;
- New market development;
- Industry-wide productivity improvement; and
- Feasibility studies involving new products expanded facilities, new technolgies, industry-wide productivity improvements or new markets.

Maximum Assistance : Combined government support for technical and direct labour and marketing salaries as well as R&D support, inventory, consultancies and subcontracts cannot exceed 75%.

Support for capital equipment and leasehold improvements to specialized structures is available for up to 50%.

Overall, WD, in concert with other government entities can provide up to 50% financial support for eligible projects.

Terms of Assistance : Provide unsecured, interest free loans. Repayment is normally restructured over a reasonable time frame after completion of the project - such as a two year repayment holiday after completion of the project followed by a five year repayment of principal.

Programme Name : **The Manufacturing Productivity Improvement Program :**

Eligible Projects : This program helps manufacturing and processing firms in specified regions of Quebec improve their competitiveness in both domestic and international markets through the use of modern technology.

Eligible Costs : Consulting Studies to develop a marketing plan or other such study related to the acquisition of new production machinery.

Maximum Assistance :

- up to 50 percent of the cost of hiring a consultant to develop a marketing plan;
- up to 25 percent of the cost of new machinery, equipment or systems that incorporate modern technology and lead to improved productivity, quality and state-of-the-art facilities;

Project costs must be at least $50,000; contributions shall not exceed $1 million; land and building costs are not eligible.

Terms of Assistance : Repayable and non-repayable contributions depending on the project.

Programme Name : **The Enterprise Development Program**

Eligible Projects : The purpose of the Enterprise Development Program is to promote entrepreneurship, improve the competitiveness of manufacturing and processing firms operating in the manufacturing and processing areas of Quebec, and encourage diversification of the industrial base.

Eligible Costs :

- Cost of studies, establishment, expansion or modernization of enterprises;
- Cost of assistance to establish services common to commercial enterprises, such as purchasing, marketing, or research and development;
- Cost of marketing, commercial and technological prospecting.

Maximum Assistance :

- up to 75 percent of the cost of hiring consultants to develop marketing plans, business plans and productivity improvement studies;
- up to 50 percent of capital costs relating to the establishment, expansion or modernization of facilities to a maximum of $2 million;
- from 25 to 50 percent of capital costs and up to 50% of operating costs in the first three years to a maximum of $750,000 for both capital and operating costs;
- up to 50 percent of the following costs: market research and analysis; participation in trade shows and conferences; and travel for technology transfer, raising capital and joint ventures opportunities; and
- up to 90 percent of the following costs: non-commercial operations studies of investment opportunities; organization of exhibitions, seminars and conferences; and delivery of specialized services or technical information.

Terms of Assistance : Repayable and non-repayable contributions depending on the project.

Programme Name :	**Atlantic Canada Opportunities Agency**
Eligible Projects :	Provides financial assistance that contributes to the establishment, development,support and promotion of small and medium-sized-enterprises. The sectors eligible for assistance under the ACOA Action Program include the following: • manufacturing and processing industries; • business services; • commercial research and development organizations; and • repair and maintenance services.
Eligible Costs :	• 85 percent of new term loans of $100,000 or more for a maximum of 15 years for companies unable to obtain financing from conventional sources; • Partial compensation for interest payable on new term loans for capital investments of more than $25,000; • management courses and technical assistance for non-commercial institutions. • financial assistance of up to 75 percent of the cost of feasibility studies, market research, venture capital or technology transfer research and up to 50 percent of the costs of hiring qualified personnel for one year to implement a marketing plan. • financial assistance of up to 60 percent of the costs of researching and developing a new product, process or service that is scientifically feasible. • financial assistance of up to 50 percent of the capital cost of establishing a new facility (projects are limited to $200,000 in eligible costs). • financial assistance of up to 30 percent of the capital cost of expanding, modernizing, replacing or relocating an existing facility (projects are limited to $200,00 in eligible costs).
Terms of Assistance :	Repayable and non-repayable contributions depending on the project.

The National Research Council

The National Research Council (NRC) is an independent research agency established to promote scientific and engineering research in furthering Canadian development. In 1989-90, the NRC's science and technology budget was $490 million. Its activities include research in direct support of industrial innovation and development; research to provide technological support of social objectives; the development and management of major national facilities; and research and services related to standards.
NRC contributions to industry include such efforts as marketing studies for companies contemplating new products. The council has established a Technology Assessment Office to identify developing technologies and opportunities for their application. The council has also set up a Technology Co-ordination Centre to promote collaboration of the NRC, industries and universities.

NRC is increasingly seeking to co-operate with industry through exchanges of personnel, sharing its laboratory facilities and joint research programs. Industrial partners are expected to contribute to research costs. Terms of co-operation are decided on a case-by-case basis.

Canadian Institute of Industrial Technology

Canadian Institute of Industrial Technology provides a complete research environment for technical teams from industry, universities and government for co-operative projects in areas such as computer integrated manufacturing, sensor-based robotics, vision systems and artificial intelligence. Project size can range from entire operations based at the institute, to small technical groups with a specific problems to solve. Services are provided on a user-pay basis.

Industrial Research Assistance Program

Industrial Research Assistance Program aims to improve the performance of small- and medium-sized enterprises by encouraging the adaption and diffusion of technology through technology transfers and assisting companies in new product development and in the modification of existing processes through:

1. The Field Advisory Service which provides information and guidance in industrial engineering methods and techniques to improve the effectiveness of company functions and production operations; and assist companies to gain access to other types of assistance offered by the NRC and other federal departments.

2. The Technical Information Service is used by small- and medium-sized businesses with few or no technical library facilities, and by larger firms to keep their technical staff informed of the latest technological developments. This group and the Field Advisory Service receive approximately 25,000 enquiries annually from some 20,000 firms.

Canada Institute for Scientific and Technical Information

Canada Institute for Scientific and Technical Information provides a wide range of information services including access to the world's published scientific literature and to computerized databases. Roughly 50 percent of its library activities and conference proceedings are provided to business firms. The institution has accumulated over 3 million titles and introduced a great many services to bring this knowledge to users.

Diffusion of Technology Through Universities and Centres of Excellence

To speed up the diffusion of innovative technologies from the laboratory to industry, a large number of technology centres were established. These centres provide technical expertise and innovations to business firms, including contract research. They are particularly well suited to the needs of small- and medium-sized firms which may not be able to afford adequate R&D.

The rate of diffusion of innovative technologies to industry has been further accelerated through the establishment by universities of industrial innovation centres. Funded in part by provincial governments, these centres assist inventors in marketing their inventions, establishing their own companies and developing entrepreneurial skills.

The University of Waterloo has set up several bodies whose function is to transfer technology to the business community. It has an extensive student employment co-operative program which makes on-the-job training part of the curriculum. It has developed an industrial R&D park on university property to bring business and university staff and students together. Moreover, the school has gone into business for itself selling computer software to industry and other institutions.

Over 20 other schools across Canada offer the same type of program. For instance, the University of Toronto, the University of Alberta, University of British Columbia, Queen's University, University of Calgary, and Memorial University have appointed permanent business liaison officers to link university activity in the research area to industry.

The Canadian Microelectronics Corporation

The federal government has established some 30 university-based centres as a computer-linked nationwide network of design and testing stations for Very Large Scale Integrated (VLSI) circuits which permit host universities to participate in a design network leading to the fabrication of prototype micro-electronic chips by Canadian manufacturers. These centres provide computer-aided design workstations linked to a host computer at a coordination centre at Queen's University in Kingston, Ontario.

Industry Science and Technology Canada and some provincial governments, including Ontario, British Columbia and New Brunswick, are also in the process of establishing microelectronics centres to fulfil the specialized needs of their industries.

Appendix 2
An Abundant Supply of Component Parts

Canada has a strong base of producers experienced in making parts and components for electronics systems. Northern Telecom and Mitel both produce components for the telecom market, while other companies such as LSI Logic, IBM and Philips operate factories which produce electronics for various other markets including personal computers.

Those parts not manufactured by local suppliers are available from other North American suppliers where Canadian companies can take advantage of Canada's superior distribution network. As one plant manager declared: 'Whether a plant is located in Tennessee or Ontario, it's next day service from California.'

Canada's leading components manufacturers have operated under 'free-trade' conditions for years. Canadian components manufacturers are successfully exporting their products to the United States to a long list of major American electronics companies, including: IBM, Apple, Unisys, Bull NH, NCR, Digital Equipment, Sun Microsystems, Hewlett-Packard, Xerox. Some also have significant businesses in the Far East, selling products and services to a group of companies that includes such heavyweights as NEC, Sanyo, Samsung, Matsushita, and Sony.

A high proportion of top electronic components makers have plants in both Canada and the US. These companies have surpassed their domestic rivals by straddling the border. Many of these companies take full advantage of Canadian strengths by providing the Canadian subsidiary with a world-wide product mandate.

Printed circuit boards, semiconductors and connectors are used to make loaded circuit boards, the most important part of any electronic system. Foreign electronics producers wanting to establish high levels of 'local content' under Free Trade, will need to find local suppliers of circuit board components including bare PCBs and connectors. Although merchant semiconductor supply is a global business, there is significant potential to source key parts from Canadian-based producers.

The Canadian PCB industry as a whole is thriving. Shipments have increased from $28 million in 1976, to more than $300 million in 1989. Canada has dozens of PCB manufacturers, including several that can manufacture quality boards in high volumes.

Their technological capabilities are high. Some make the multilayered boards used in processors which have many levels of circuitry. They also make specialized boards for mounting hybrid integrated circuits. These products are mostly sold to military and telecom clients. Canada's top PCB makers also make boards for surface-mount components. These components are required in growing numbers by electronics producers.

A Sample List of Electronics Firms Located in Canada

Company Name	Product Manufactured
ATI Technologies Inc.	Graphics cards for personal computers
CAE Electronics Ltd.	Flight simulators, and electronic components
Circo Craft Co. Inc	Printed circuit boards
Circuit Graphics Ltd.	Printed circuit boards
Gandalf Technologies Inc.	Modems and terminal adapters
Gemini Technology Inc.	ASICs
Graphico Electronics Group	Printed circuit boards
IBM Canada	Components (power supplies, cards)
International Semi-Tech Inc.	Computers and components
LSI Logic Canada	ASICs
M.E.L Defence Systems Ltd.(Lockheed)	Electronic naval equipment
Mitel Semiconductor	ICs and telephone switching systems
Mosaid Inc.	ICs and computer memory testing equipment
Newbridge Microelectronics Systems	Semiconductors, telephone equipment
Northern Telecom	Telecommunications hardware and software
P.C. World (Helix Circuits Inc.)	Printed circuit boards
Philips N.V.	Computer equipment and computers
Spar Aerospace Ltd.	Communications equipment, aerospace
Unisys Canada Inc.	Combat test systems and computer components (power supplies)

Appendix 3
After-Tax Cost of R&D Performed in Ontario
Sample Calculations

Example 1 : Ontario Manufacturing Corporation -

Assume :
- R&D Expenditure of $100,000, all eligible expenditures;
- All income is generated from manufacturing activities;
- Corporation operates in Ontario;
- Tax rate 23.84% federal, 15.5% provincial.

Revenue		$1,000,000
Cost of Goods Sold		400,000
Gross Margin		600,000
Expenses:		
Operating Expenses	150,000	
R&D Expenditure (eligible portion)[1]	80,000	230,000
Net Income		370,000
Tax on Income (combined, @39%)		144,300
Federal R&D Credit		20,000
Provincial R&D Superallowance		4,600
Tax Payable		119,700
Tax Savings from R&D[2]	$ 55,800	
After-Tax cost of $100,000	$ 44,200	

Notes :
1. Eligible portion of R&D expense is net of tax credits (ie. $100,000-$20,000).
2. Tax savings is computed as follows :

Write-off of eligible portion ($80,000 x 39%)	$ 31,200
Federal Tax Credit	$ 20,000
R&D Superallowance	$ 4,600
Total Tax Savings	$ 55,800

Appendix 4
After-Tax Cost of R&D Performed in Quebec
Sample Calculations

Example 2 : Quebec Manufacturing Corporation -

Assume :
- R&D Expenditure of $100,000, all eligible expenditures;
- All income is generated from manufacturing activities;
- Corporation operates in Quebec (except Gaspé);
- Tax rate 23.84% federal, 7% provincial.

Revenue		1,000,000
Cost of Goods Sold		400,000
Gross Margin		600,000
Expenses:		
Operating Expenses	150,000	
R&D Expenditure (eligible portion)[1]	64,000	214,000
Net Income		386,000
Tax on Income (combined, @31%)		$ 119,660
Federal R&D Tax Credit		$ 16,000
Provincial R&D Tax Credit		$ 20,000
Tax Payable		$ 83,660

Tax Savings from R&D[2]	$ 55,840
After Tax Cost of $100,000 of R&D	$ 44,160

Notes :
1. Eligible portion of R&D expense is net of tax credits (ie. $100,000-$20,000-$16,000).
2. Tax savings is computed as follows :

Write-off of eligible portion ($64,000 x 31%)	$ 19,840
Federal Tax Credit	$ 16,000
Provincial Tax Credit	$ 20,000
Total Tax Savings	$ 55,840

Appendix 5
After-Tax Cost of R&D Performed in Other Provinces
Sample Calculations

Example 3 : Manufacturing Corporation in a Province without an R&D Credit -

Assume :
- R&D Expenditure of $100,000, all eligible expenditures;
- All income is generated from manufacturing activities;
- Corporation operates in Canadian province with no special R&D treatment;
- Federal tax rate is 23.84%, provincial tax rate is 16%.

Revenue		$1,000,000
Cost of Goods Sold		$ 400,000
Gross Margin		$ 600,000
Expenses:		
Operating Expenses	$ 150,000	
R&D Expenditure (eligible portion)	$ 80,000	$ 230,000
Net Income		$ 370,000
Tax on Income (combined, @39%)		$ 144,300
Federal R&D Tax Credit		$ 20,000
Tax Payable		$ 124,300
Tax Savings from R&D		$ 51,200
After Tax Cost of $100,000 of R&D		$ 48,800

Notes :
1. Eligible portion of R&D expense is net of tax credits (ie. $100,000-$20,000).
2. Tax savings is computed as follows :

Write-off of eligible portion ($80,000 x 39%)	$ 31,200
Federal Tax Credit	$ 20,000
Total Tax Savings	$ 51,200