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Canada Centre
for Mineral
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Technology

Centre canadien
de la technologie
des minéraux
et de l'énergie

CANADIAN FEDERAL ACTIVITIES AND INCENTIVES FOR SCIENCE

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(CANMET)

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ENERGY RESEARCH PROGRAM
ENERGY RESEARCH LABORATORIES
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INDEX

	PAGE
ABSTRACT	iii
INTRODUCTION	
Implication of the Federal Target for R&D.....	1
Canada Lagging in R&D Expenditures.....	2
MINISTRY OF STATE FOR SCIENCE & TECHNOLOGY (MOSST)	
Objective	6
Organization	6
University Branch	6
Government Branch	6
Industry Branch	7
FEDERAL SUPPORT FOR INDUSTRIAL R&D (Instruments)	
Information Service.....	9
Support for Industrial Research, Innovation and Product Development	10
Tax Measures	12
Government Research and Technology Transfer.....	12
NATURAL SCIENCE AND ENGINEERING RESEARCH COUNCIL (NSERC)	
Background Information	16
Objective for the 5-Year Plan	16
Program Budgets	16
NATIONAL RESEARCH COUNCIL (NRC)	
Activities	20
Budget	22
FEDERAL GOVERNMENT INTRAMURAL EXPENDITURES	
Departmental Budgets Directed to	
Scientific Activities	24
Activities of Department of Energy Mines & Resources	25
EMR Expenditures for Scientific Activities	26
FEDERAL GOVERNMENT EXTRAMURAL EXPENDITURES ON SCIENTIFIC ACTIVITIES	
Background	28
Federal Expenditures on Performing Sectors	28
Federal Science Activities in Industry	30
Federal Science Activities in Provinces.....	33
REFERENCES	35

CANADIAN FEDERAL ACTIVITIES

AND

INCENTIVES FOR SERVICE

by

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ABSTRACT

This report outlines the various facets of the Canadian Federal Science and Technology activities reflecting the policy of increasing the national performance of research and development to a level approaching that of the more industrialized nations belonging to the Organization for Economic Cooperation and Development. The year 1985 has been set as the date for having Gross Expenditures on Research and Development (GERD) reach 1.5% of Gross National Product (GNP).

The various activities are expressed in general terms of expenditures and person years spent on areas of endeavour. Comparisons for the last 3 to 5 years up to this fiscal year, 81/82 are given to show trends. Federal programs and incentives for promoting industrial R & D are also highlighted.

A list of references is provided for readers seeking more detailed information.

LES ACTIVITÉS DU GOUVERNEMENT FÉDÉRAL AU CANADA
DANS LE DOMAINE DES SCIENCES ET LES PROGRAMMES
D'ENCOURAGEMENT DANS CE DOMAINE

par

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RÉSUMÉ

Ce rapport décrit brièvement les différentes activités du gouvernement fédéral dans le domaine de la science et de la technologie. Ces activités font suite à la politique qui veut accroître la recherche et le développement au pays à un niveau semblable à celui des pays plus industrialisés de l'OCDE. Le rapport propose comme objectif que les dépenses brutes en recherches et développement (DBRD) atteignent en 1985 le niveau de 1.5% du produit national brut (PNB).

Les différentes activités sont décrites quant aux dépenses et année-personnes allouées à chaque activité. Sont établies aussi les données semblables, pour les trois à cinq années qui précèdent l'année fiscale 1981/82. Le rapport souligne aussi les programmes d'encouragement du gouvernement fédéral pour la promotion de la recherche et du développement.

INTRODUCTION

Canada has a target which calls for Gross Expenditures on R&D (GERD) to be 1.5% of the Gross National Product (GNP) by 1985.

Implications of the Federal Target for R&D

The required increase in GERD must keep pace with economic growth, since the target is expressed in terms of GNP. In constant dollars, GERD must nearly double over the next five years. As seen in Table 1, industry's share as a funder will increase from just over one third in 1979 to 50% assuming 1985 goal. As a performer, the figure will go up from 44% to 63%.

Consistent with the above assumption about industry's share of GERD - 1985, the federal government's share of funding R&D would drop to about 33% compared to its 1979 share of 39% (which makes it the largest funder). Nevertheless, its expenditures for R&D would not decline. Rather they would have to grow annually by over 8% in real terms, or about 17% in current dollar terms, and increase to 0.5% of GNP.

In line with existing policies, such as restricting the size of the public service and of contracting-out its science requirements, much of the growth in its science expenditures would be spent on contracts and grants for industrial R&D and in support of university research.

A comparison is given in Table 1 of sectoral shares of GERD in 1979 and in 1985, illustrating the above target.

TABLE 1

Sector Impact of R&D Target

SECTOR	AS A FUNDER		AS A PERFORMER	
	1979	1985	1979	1985
	(percent)		(percent)	
Federal	39	33	26	16
Provincial	7	6	4	2
Business	36	50	44	63
Universities	14	8	26	18
Others	4	3	1	1

Canada Lagging in R&D Expenditures

Expenditure data collected by the Organization for Economic Cooperation and Development (OECD) covering most western countries' R&D efforts show Canada's R&D expenditures to be lagging well behind those of the industrialized leaders. (Table 2) Our low R&D investment is a matter of concern. Some structural reasons have been identified as the source of this deficiency. Relatively more Canadians are employed in the resource and service sectors where R&D tends to be lower. Furthermore, Canada does not have the massive space and defence research programs that are such a significant portion of the U.S. effort. Nevertheless, Canada cannot afford to lag so far behind in its research investments.

Coupled with the relatively low level of Canada's scientific effort is the low level of involvement of the private or business sector. Both as funder and as performer of R&D, the Canadian business sector as a whole trails behind its international competition (Table 3).

TABLE 2

1977 International Comparison of R&D Funding by Sector

COUNTRY	GOVERNMENT	UNIVERSITY	INDUSTRY	OTHER	TOTAL
	(% GERD of EGP of GNP)				
Australia	0.51	0.13	0.24	0.03	0.9
Belgium	-	-	-	-	1.2
Denmark	0.25	0.18	0.46	0.01	0.9
Finland*	0.28	0.15	0.55	0.02	1.0
France*	0.68	0.10	0.74	0.28	1.8
Germany	0.83		1.11	0.06	2.0
Iceland	0.47	0.01	0.05	0.08	0.6
Ireland	0.34	0.06	0.25	0.05	0.7
Italy	0.40		0.46	0.04	0.9
Japan	0.27	0.19	1.12	0.12	1.7
Netherlands	-	-	-	-	1.8
Norway	0.38	0.30	0.49	0.03	1.2
Sweden	0.49	0.24	1.13	0.05	1.9
Switzerland	0.43		1.73	0.04	2.2
United States	1.22	0.07	1.05	0.05	2.4
Canada, GDP**	0.43	0.13	0.30	0.04	0.9
(fed/prov) (0.37/0.06)					
Canada, GNP	0.46	0.14	0.32	0.04	0.96
(fed/prov) (0.39/0.06)					

*Includes some or all Social Science and Humanities R&D. All others are Natural Sciences and Engineering only. Source: OECD, International Statistical year, 1977.

**Gross Domestic Product, which differs slightly from GNP used in Canada

These international comparisons, though useful, must be used with some caution, as there are differences among countries in their concepts and definitions of R&D. Also, expenditure figures do not always measure effectiveness.

TABLE 3

Business Sector Share of GERD (NS), 1977

COUNTRY	AS FUNDER	AS PERFORMER
	(% OF TOTAL)	
Australia	26.2	26.9
Belgium	-	72.2
Canada	35.7	42.4
Denmark	51.3	55.7
Finland	55.3	56.1
France*	41.1	60.3
Germany	55.6	68.4
Iceland	7.8	5.3
Ireland	35.5	34.9
Italy	51.0	57.8
Japan	65.8	65.2
Netherlands	-	57.2
Norway	40.8	53.5
Sweden	59.3	71.0
Switzerland	78.7	77.3
United States*	43.9	66.8

*Includes Social Sciences and Humanities R&D. Source: OECD, International Statistical year, 1977

Although science spending demonstrated little consistent real growth, the economy itself grew substantially. The relative proportion of Canadian economic activity devoted to R&D expenditures has therefore declined since 1967, when the GERD/GNP was 1.29%.

There is some indication that the proportion of our scientific effort performed and funded by the business sector is increasing (Table 4). Increased tax incentives and other government policies such as contracting-out the government scientific activities are designed to encourage greater involvement of Canadian business and industry in R&D and should reinforce this trend.

TABLE 4Industrial Participation in Canadian GERD

<u>Year</u>	<u>AS A FUNDER</u>	<u>AS A PERFORMER</u>
	<u>(Percent of GERD)</u>	
1970	31.4	38.9
1980	34.9	43.4

MINISTRY OF STATE FOR SCIENCE & TECHNOLOGY

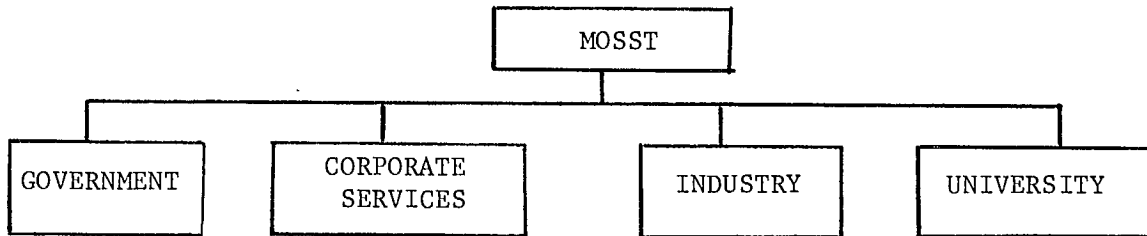
(MOSST)

OBJECTIVE

Developing policies for and advising the government on the use of science and technology in support of national goals'.

ORGANIZATION

The ministry's three operational branches carry out the policy functions and work on a variety of projects.

University Branch

The University Branch has the responsibility of advising the Government on policies concerning the federal support of university research through the Granting Councils and other federal departments and agencies. It also advises on policies concerning the involvement of university research in the pursuit of national objectives as well as policies concerning involvement of university researchers in the formulation of science policies.

At a time when the federal government is dedicated to raising the national expenditures on research and development, the University Branch has been studying the present and future requirements which these increased expenditures will have upon the availability of research-trained manpower.

GOVERNMENT BRANCH

Government Branch has an overall responsibility within MOSST for projects which have a direct impact upon those government policies and activities involving scientific and technological issues. The federal government's multifaceted activities in science and technology now span five budgetary

envelopes and more than one hundred programs in over fifty departments and agencies.

The branch is also responsible for major study on the applicability of Canada's domestic R&D to development problems in the Third World.

INDUSTRY BRANCH

The Industry Branch is specifically responsible for developing and adapting policies for the support and encouragement of industrial research and development and innovation which in turn enhance economic growth and productivity in Canada. In this regard, industrial research and development make a substantial and immediate contribution to the growth of the economy.

Government ~~procedure~~^{procurement} is recognized as an effective instrument to support industrial R&D. In 1979-80, the branch played a major role in the preparation of the guidelines of the Procurement Policy Advisory Committee chaired by the Deputy Secretary of the Treasury Board. It also participated in the development of the guidelines for procurement review committees to plan large procurement valued between \$2 million and \$100 million.

Another favoured method of supporting industrial R&D is the use of tax incentives. Each of the last three budgets included tax measures designed to stimulate industrial R&D. During the past year, the branch has analyzed data collected by Statistics Canada and the Department of National Revenue to determine the effects of these tax incentives.

FEDERAL SUPPORT FOR INDUSTRIAL R&D

(Instruments)

SUMMARY: RESEARCH, INNOVATION AND PRODUCT DEVELOPMENT

<u>Program or Service</u>	<u>Purpose and Description</u>	<u>Form of Assistance</u>
<u>INFORMATION & SERVICE</u>		
National Research Council (NRC)	Assists and advises business on technological and scientific problems, also provides testing and research facilities.	Assistance is on request for problems in which NRC has expertise.
Technical Information Service (TIS)	Provides in-plant technological assistance and information services.	In-plant studies and advice.
Canadian Institute for Scientific and Technical Information (CISTI)	Collects scientific information and makes it available at minimal cost for specific requirements.	Tailored research reports available to individual forms.
Patent Office	Provides 17 years patents for new inventions (products and processes), and public disclosure of inventions and patentees.	Patents granted; new patents published; copies of new patents available.
Canadian Patents and Development Limited (CPDL)	Makes available to industry research findings, from government and non-profit organizations, through patent licensing and other product development services.	Arranges licenses between inventor and user; assesses invention marketability and recommends further development. Supports Inventors' Assistance Program. Maintains an

<u>Program or Service</u>	<u>Purpose & Description</u>	<u>Form of Assistance</u>
		inventory of available inventions and government technology.
Trade Marks	Administration of Trade Marks Act, which gives owner of a registered trade mark 15 year exclusive right	Trade Marks Office grants trade mark, maintains public record.
<u>SUPPORT FOR INDUSTRIAL RESEARCH INNOVATION & PRODUCT DEVELOPMENT</u>		
Industrial Research Assistance Program (IRAP) and Mini-IRAP Program	Aids industrial research in Canada and finances projects with high technological and economic pay off. IRAP supports in-house projects, and Mini-IRAP supports projects for smaller companies undertaken in research organizations.	Pays salaries, involving about 50% of research project costs.
Scientific & Technical Employment Program (STEP)(also STEPEX)	STEP subsidizes hiring of unemployed scientists engineers and technicians for new and significant initiatives. STEPEX subsidizes unemployed research staff hired by universities and research institutes for projects requested by private sector firms.	Subsidy per scientist engineer or technician hired on approved projects for one year.

<u>Program or Service</u>	<u>Purpose & Description</u>	<u>Forms of Assistance</u>
Industrial Post- Doctoral Fellowships	Subsidize cost of employing graduates in industrial research.	Subsidy of \$13,000 plus travel costs for one year.
Industrial Energy Research & Development Program (IERD)	Encourages research on products and processes which reduce energy consumption.	Grants of up to 50% of project cost.
Enterprise Development Program (EDP)	Assists with product development costs, including high risk innovative projects, proposal preparation, and industrial design.	Grants of up to 75% of costs.
Design Canada	Encourages better Canadian design and product development.	Financial incentives, management training, technical advisory assistance, information seminars and encouragement of design professions.
Standards Council of Canada	Promotes standardization.	Advice: contributions to organizations.
Defence Industry Productivity Program (DIP)	Sustains and develops technological capability for defence or civil export sales arising from defence production capability.	Grants of up to 50% and loans for development projects, financing of approved capital equipment.

<u>Program or Service</u>	<u>Purpose & Description</u>	<u>Forms of Assistance</u>
Program of Assistance to Solar Equipment Manufacturers	Stimulates design development and manufacture of solar equipment and systems.	Proposal and development contracts.
Canada-Saskatchewan Heavy Oil Development Agreement	To develop enhanced methods of recovering heavy oil.	Grants of up to 50% of capital cost of projects.

TAX MEASURES:

-immediate write-offs	Immediate 100% write-off of current and capital expenses for R&D	Expenses can be fully written-off in year incurred.
-Special Deduction for Increased R&D	Additional income deduction for companies which are increasing Canadian R&D efforts	Deduction of 50% of increase over previous 3 year average, allowed until 1988.
-Investment Tax Credit (ITC)	Deduction from Corporate taxes for qualifying current and capital R&D	10 to 20% tax credit for R&D by small Canadian private business

GOVERNMENT RESEARCH AND TECHNOLOGY TRANSFER

Contracting-out	Encourages private sector research for government requirements.	Department of Supply & Services manages contracting system and maintains lists of potential contractors.
Unsolicited Proposals Program	Funds research proposals developed independently	Proposals are reviewed and may be funded

<u>Program or Service</u>	<u>Purpose & Description</u>	<u>Forms of Assistance</u>
	by private sector, which further government research objectives.	initially by DSS for a sponsoring department.
Program for Industry/ Laboratory Projects (PILP)	Promotes transfer to industry of NRC research results, and development of their commercial potential.	Financial and other assistance, up to full underwriting of company's project/product development costs.
Project Research Applicable in Industry	Support to universities to encourage commercial exploitation of university research.	Grants.
Strategic Grants in Aid of Research	Support to universities for research in areas of national concern (eg. energy, environment).	Grants.
<u>INDUSTRIAL RESEARCH FACILITIES</u>		
Industrial Research Institute Program (IRIP)	University research institutes provide research services for industry	Firms contract with the university on cost-recovery basis.
Centres for Advanced Technology	Provide advanced technology research capability for industry use.	Firms contract with the centre on cost-recovery basis.
Industrial Research Associations	Provide research capability in specific fields (presently in welding, gas and sulphur industries).	Firms contract with the association on cost-recovery basis.

<u>Program or Service</u>	<u>Purpose & Description</u>	<u>Forms of Assistance</u>
Rapeseed Utilization Assistance Program (RUAP)	Research and development for improving manufacture of rapeseed products	Grants to Rapeseed Association of Canada which funds research in universities and institutes.
Protein, Oil & Starch (POS) Pilot Plant Corporation	Develops technology for processing grains and oilseeds.	Offers facilities for development work.

NATURAL SCIENCES AND ENGINEERING RESEARCH COUNCIL

(NSERC)

Background

The Natural Sciences and Engineering Research Council was established on May 1, 1978. The Council membership is made up of 21 members plus the President with an approximate 40 - 60 mix of business and academic representatives respectively.

Shortly after its formation in May of 1978, NSERC was requested to develop a five-year plan for the research granting function it had inherited from the National Research Council. The Council responded in 1979 with a plan which assessed its role in the context of the national R&D expenditure target equivalent to 1.5% of the gross national product. It presented new as well as modified programs which were consistent with, and in some cases essential to, the achievement of that national target.

NSERC is Canada's largest single funder of university research endeavours and the major source of scholarship funding for postgraduate students and postdoctoral fellows. In 1980-81, it received approximately 14,000 requests for research grants and scholarship support and made almost 10,000 awards.

Objectives of the 5-Year Plan

The top priorities of its Five-Year Plan are to increase the number of highly-trained researchers in Canada and to attack the serious problem of obsolescence of university research equipment. The other two objectives are; to direct a larger share of the research budget to activities having a direct relevance to identified areas of national concern, and within the context of the above, to protect and improve the major Council program of "free" or "curiosity-driven" research which is largely unique to the university community and which is essential for any balanced program of national research effort.

Program Budgets

The council's current budget of \$181.5 million for 1981-82, which already reflects an increase of \$18.9 million to cover cost increases, will be increased by a further \$20 million, bringing the total budget to \$201.5 million, an annual increase of 23.9%. The funding decision will permit the Council to maintain and expand on the important initiatives of its Five-year Plan which were started in 1980. Coupled with last year's increase of 67%

over the first two years of its plan or 40% exclusive of allowance for inflationary increases.

Tables 5, 6 compare the total budget of the Council in the last three years and the allocation of these funds to major program activities. Expenditures on manpower training and equipment purchase, the top two priorities of the Five-year Plan, have more than doubled over the first two years of the plan.

TABLE 5

Expenditures by Major Thrust of Five-Year Plan
(millions of 1981 dollars)

	Actual Expend. 1979-80	Actual Expend. 1980-81	<u>Forecast Expenditures, 1981-82</u>		
			<u>Previous Forecast</u>	<u>New Funds</u>	<u>Present Forecast</u>
Manpower	15.5	21.9	30.0	-	30.0
Equipment	17.9	33.0	19.5	15.3	34.8
Targeted Research	13.1	18.8	20.0	2.5	22.5
Free Research	89.1	91.6	94.6	1.3	95.9
General Programs	10.2	11.8	13.0	0.7	13.7
Administration	<u>2.8</u>	<u>4.1</u>	<u>4.3</u>	<u>0.2</u>	<u>4.5</u>
Total Budget	148.6	181.2	<u>181.4</u>	20.0	<u>20.14</u>

TABLE 6

Summary of NSERC's Budget

PROGRAM	Science Resources					
	1979/80		1980/81		1981/82	
	\$M	PY	\$M	PY	\$M	PY
Scholarships and Grants in aid of Research	118.7*	--	159.6*	--	177.7*	--
Administration	2.2	61	3.6	75	4.3	81
TOTAL	121.0	61	163.2	75	182.0	81

*Includes funds from NATO (\$0.6 million in 1981/82)

The estimated expenditures of \$182.0 million to be made in 1981/82 by the Natural Sciences and Engineering Research Council are \$18.8 million or 12% higher than forecast expenditures in 1980/81 and \$61.0 million or 50% higher than in 1979/80.

95% of the Council's grant budget is used to support research and research training in Canadian Universities.

NATIONAL RESEARCH COUNCIL

(NRC)

Activities

The National Research Council of Canada is a departmental crown corporation with a governing council, consisting of a President and 21 members appointed by the Governor-in-Council. The estimated expenditures for 1981/82 are \$274.1 million, an average of 15.5% over 1980/81. The Council has a broad mandate "to promote, assist and undertake scientific and industrial research".

The Council has recently prepared a long-range plan developed in the context of the current national economic situation. This plan, which provides a blueprint for the council's role and activities over the next decade, stresses the requirement for an immediate increase in the R&D needed to enable Canadian industry to manufacture and export more high technology products. The plan has been submitted to the government for consideration.

The National Research Council is the second largest funder of industrial S&T activities. Council payments to industry for 1981/82 are estimated to be \$62.2 million, an increase of \$7.9 million from 1980/81. Ninety-eight percent of the National Research Council's industrial funding is for R&D. It is almost equally divided between contracts (\$33.6 million) and grants and contributions (\$27.4 million). About one-third of the contracted R&D has occurred under the council's technology transfer mechanism known as Program for Industry/Laboratory Projects (PILP). In 1981/82, this program is being amalgamated with the Cooperative Projects with Industry program and some funding will be provided as contributions to cooperating firms. The Industrial Research Assistance Program (IRAP) of NRC provides grants to assist in the development of R&D capability in Canadian industry, by awarding funds to cover the salaries and wages of R&D staff working on approved projects. Canadian companies engaged in projects with significant technical content are eligible. Estimated expenditures in 1981/82 are 22.8 million compared to \$21.6 million in 1980/81, and \$19.5 million in 1979/80. The National Research Council estimates that a further \$4.6 million will be spent in 1981/82 in other grants and contributions to industry; support for the later developmental phases is provided by the Enterprise Development Program, the Defense Industry Productivity Program and the Industrial Energy Research and Development Program of the Department of Industry, Trade and Commerce. A part of the Industrial Research Assistance Program is

specifically directed to meeting the needs of small-companies that have some technologically related question, problem or opportunity but do not have the internal capacity to investigate it. The program encourages small companies to find the outside resources which can help it in the solution of its technical problem. These resources may be in a provincial research organization, or a university or private consultants.

The council is also making known and accessible to industry its own material and human resources, and is conducting a substantial amount of intramural research of benefit and assistance in developing new capabilities in selected industrial sectors. While such research is carried out, mainly in the engineering divisions, there are projects in all its divisions which are of significance to Canadian industry in improving manufacturing techniques or developing new products and processes.

Scientific and technical information services are another means for encouraging the application of new technology in Canadian industry. Within the National Research Council's Scientific and Industrial Research Program, the Canada-wide Technical Information Service has as an objective the fulfillment of the technical information needs of industry, particularly small business, which often operates without an internal R&D capability. Annually the service receives 20,000 to 25,000 enquiries, and provides in-depth assistance to 500 to 700 firms. Total estimated expenditures 1981/82 for the service are \$3.3 million, compared to \$2.8 million in 1980/81.

In the International sphere the council continues to represent Canada's scientific and engineering community within the International Council of Scientific Unions and eighteen of its components, as well as in eight international engineering organizations. The council also continues to share with the Canadian Engineering Societies Committee in the activities of the World Federation of Engineering Organizations and the Pan-American Union of Engineering Societies. The International Energy Agency, (IEA) is an important focus for international cooperations in research and development on renewable energy, energy conservations, and nuclear fusion. The Council now participates on behalf of Canada in 16 of its projects in cooperation with institutions in other countries.

BUDGET

TABLE 7

NRC Expenditures for Scientific Activities

PROGRAM	SCIENCE RESOURCES						TOTAL RESOURCES	
	1979/80		1980/81		1981/82		1981/82	
	\$M	PY	\$M	PY	\$M	PY	\$M	PY
Scientific and Industrial Research	187.8*	2,945	221.2*	2,913	254.9*	2,946	255.2	2,946
Scientific and Technical Information	13.6**	215	16.2	212	19.2	226	19.2	226
TOTAL	201.4	3,160	237.4	3,125	274.1	3,172	274.4	3,172

*Includes the end of transfers from and to other government departments (\$1.1 million in 1981/82)

**The technical information service (\$2.6 million) was transferred to the Scientific and Industrial Research Program April 1979.

FEDERAL GOVERNMENT INTRAMURAL EXPENDITURES

ON SCIENTIFIC ACTIVITIES

TABLE 8

DEPARTMENTAL BUDGETS DIRECTED TO SCIENTIFIC ACTIVITIES (1981/82)

MAJOR FUNDERS

DEPARTMENT/ORGANIZATION	SCIENCE RESOURCES		TOTAL RESOURCES	
	\$M	PY	\$M	PY
Agriculture	170.1	4,075	910.4	10,616
Communications	57.6	651	140.8	2,025
Energy, Mines & Resources	275.7	2,441	4,019.4	4,269
Atomic Energy of Canada, Ltd	115.5	2,427	166.5	3,428
Environment	286.8	4,935	618.7	11,594
Canadian International Development Agency	41.5	57	787.1	1,029
Fisheries and Oceans	119.8	2,211	404.0	5,831
Industry, Trade and Commerce	127.1	344	612.2	2,825
National Defence	110.2	1,935	6,150.7	117,345
National Health and Welfare	74.1	1,416	17,527.1	9,293
Medical Research Council	88.6	39	88.6	39
Internal Development Research Centre	45.5	238	49.8	353

Activities of the Department of Energy, Mines and Resources

The objective of the department's Energy Program is to ensure the availability and to promote the effective use of energy resources for Canada, with due regard for other social and economic goals. The principal departmental groups concerned with energy S&T are the Canada Centre for Mineral and Energy Technology which conducts energy research in its laboratories and pilot plants; the Geological Survey of Canada, involved in studies of oil, gas and uranium resources; the Earth Physics Branch, studying geothermal potential, and the Office of Energy Research and Development, which provides coordination and facilitates improved management of the government's total energy R&D program. The Conservation and Renewable Energy Branch has been consolidated with the Electrical, Coal, Uranium and Nuclear Group to facilitate policy coordination among the non-petroleum energy options.

Energy R&D at the Canada Centre for Mineral and Energy Technology is focused primarily on fossil fuels such as oil sands and coals, in which the centre has exercised technological leadership for many years. Substitution for oil, efficiency of use, and development of low-grade resources are stressed. Demonstration projects with the centre's participation, complemented by in-house and contract research, are underway or contemplated in such areas as fluidized-bed technology, coal-oil mixture combustion and heavy oil, upgrading. In addition to its energy R&D program, the Canada Centre for Mineral and Energy Technology (CANMET) also conducts S&T activities with the objective of ensuring that Canadian industry has the technology needed to meet national mineral and energy goals and to maintain a competitive position in world market. The centre's research program and information and advisory services extend from resource assessment to end use for a variety of mineral commodities. In its mineral technology work, the centre stresses problems and opportunities that are peculiar to the Canadian scene. Projects are designed to maximize the efficiency of materials and energy utilization while keeping environmental pollution and health and safety hazards at a minimum.

Cooperation and collaboration with private industry is a tradition at the centre. Through contracts, joint projects and a sophisticated information transfer system, the centre works to ensure that industrial needs are met and that technical capability is available to prudent and efficient

resource development in Canada.

EMR Expenditures for Scientific Activities

The department's total estimated expenditures for scientific activities in 1981/82 are \$275.7 million, an increase of \$76.5 million or 38% over 1980/81, reflecting major increases for energy R&D and demonstrations in the National Energy Plan. These S&T expenditures will be 28% of total departmental expenditures, exclusive of expenditures for oil import compensation. Extramural expenditures are estimated to be \$129.7 million, to industry, \$1.6 million to universities and \$89.7 million to provincial governments. The payments to industry represent an increase of 29% from 1980/81, those to provinces an increase of 32%. (See Table 9)

TABLE 9

EMR Expenditures for Scientific Activities

PROGRAM	Science Resources						Total Resources	
	1979/80		1980/81		1981/82		1981/82	
	\$M	PY	\$M	PY	\$M	PY	\$M	PY
Administration	-	-	-	-	-	-	20.1	431
Energy	60.5*	46	90.0*	49	151.1*	134	3833.7***	811
Minerals and Earth Science	102.2**	2357	110.2**	2343	124.6**	2307	165.6	3027
TOTAL	162.7	2403	200.2	2392	275.7	2441	4019.4	4,269

* Excludes transfers to other departments (\$32.5 million in 1981/82)

** Includes transfers from other departments (1.1 million in 1981/82)

*** Includes Oil Import Compensation \$2,655.4 million in 1981/82)

FEDERAL GOVERNMENT EXTRAMURAL

EXPENDITURES ON SCIENTIFIC ACTIVITIES

Background

The government funds activities in science and technology (S&T) which are performed either in its own establishments (intramurally) or are performed (extramurally) in other sectors of the economy, eg. University, Industry, Provincial. S&T activities are funded or undertaken to pursue the policy of strengthening the R&D capacity of the country, particularly in industry. The Federal government's share of GERD (see page 1) is 0.5% of GNP or one third of the total, while the target for industry funding of R&D would be 0.75% of GNP or one half of the country's GERD. The balance of 0.35% of GNP would be funded by the provincial governments, universities and other sources.

There are some 60 departments and agencies reporting scientific expenditures undertaken within a total of over 100 budgetary programs, each with its particular goals and objectives. Against this background one can perceive some major roles which the government plays in its support of research and development (R&D). Thus the government's role in funding or performing R&D can be said to act in support of industry, in support of university research, or to support the attainment of some specific departmental mission, eg. to ensure the safety and efficiency of human and veterinary drugs in Canada.

The government also attempts to create an enhanced capacity for innovation through tax, tariff, patent, competition, trade and special procurement policies and special transfer payments to the province.

Federal Expenditures on Performing Sectors

The government's expenditures classified by performing sector are given in Table 10 for the 5-year period, 77/78 to 81/82. Driven mainly by increased support for R&D in the natural sciences, government expenditures for all science activities are estimated to increase in 1981/82 to \$2,548 million, an increase of \$369 million or 17% over the current year, which in turn increased by \$288 million or 15% over 1979/80 expenditures. Expressed as a proportion of the total science expenditures, intramural performance peaked in 1978/79, declined in 1979/80, and remains at about the same level in 1980/81 and in 1981/82. The proportions performed by the industry and university sectors have remained comparatively stable since 1978/79.

FEDERAL EXPENDITURES ON SCIENTIFIC ACTIVITY BY PERFORMER

Performer	1977/78	1978/79	1979/80	1980/81	1981/82
(millions of dollars and (%))					
TOTAL	1,673.0 (100)	1,809.0 (100)	1,891.8 (100)	2,179.3 (100)	2,548.1 (100)
INTRAMURAL	1,070.0 (64)	1,188.3 (66)	1,202.2 (64)	1,351.5 (62)	1,601.7 (63)
EXTRAMURAL	603.0 (36)	620.8 (34)	689.6 (36)	827.8 (38)	946.4 (37)
Industry	262.2*(16)	254.3 (14)	273.4 (14)	327.9 (15)	380.4 (15)
University	223.8 (13)	244.9 (14)	256.1 (14)	319.8 (15)	351.2 (14)
Private Non-Profit	23.4 (1)	27.4 (1)	25.7 (1)	26.3 (1)	28.4 (1)
Provincial & Municipal					
Governments	24.9 (1)	29.6 (2)	68.8 (4)	84.1 (4)	111.7 (4)
Other Canadian	23.5 (1)	17.6 (1)	16.1 (1)	16.3 (1)	15.5 (1)
Foreign	45.1 (3)	47.0 (3)	49.5 (3)	53.5 (2)	59.2 (2)

* Includes payments under the Industrial Research and Development Incentives Act (IRDIA); \$16.4 million.

The government's extramural expenditures classified by performer are detailed for the last three years in Table 11.

TABLE 11

Federal Extramural Science Expenditures

	1979/80	1980/81	1981/82
	(millions of dollars and (%))		
TOTAL	689.6 (100)	827.8 (100)	380.4 (100)
% of Total S&T	36%	38%	37%
Industry	273.4 (40)	327.9 (40)	380.4 (40)
University	256.1 (37)	319.8 (39)	351.2 (37)
Canadian Non-profit Institutions	25.7 (4)	26.2 (3)	28.4 (3)
Provincial & Municipal Governments	68.8 (10)	84.1 (10)	111.7 (12)
Foreign	49.5 (7)	53.5 (6)	59.2 (6)
Others	16.1 (2)	16.3 (2)	15.5 (2)

Federal Science Activities in Industry

Over the 5-year period S&T payments to industry have increased 52%. The government's direct support of industry S&T activities is estimated to reach \$380.4 million, an increase of 16% over forecast expenditures of \$327.9 million in 1980/81 and a 30% increase over 1979/80 expenditures. Data on departmental payments to industry to support S&T activities is given in Table 12. Some of the more readily recognized support programs under which these payments are made are shown in Table 13.

TABLE 12

Federal Science Expenditures in Industry

	1979/80	1980/81	1981/82
	(millions of dollars)		
TOTAL PAYMENTS TO INDUSTRY	273.4	327.9	380.4
R&D GRANTS AND CONTRACTS (TOTAL)	218.0	264.1	308.3
Mission-oriented R&D Contracts (total)	93.0	113.3	130.3
Communications	4.1	7.9	8.9
Energy Mines & Resources	6.6	6.8	11.5
Atomic Energy of Canada Limited	9.8	10.4	9.8
Environment	7.7	9.7	10.5
Fisheries and Oceans	2.9	3.0	4.8
National Defence	23.3	28.8	34.6
National Research Council (excluding PILP)	15.8	21.2	23.0
Supply & Services (Unsolicited Proposals)	10.3	10.3	10.5
Transport	5.5	6.8	9.5
Others	7.0	8.4	7.2
Technology Transfer R&D contracts (TOTAL)	9.1	11.9	12.7
National Research Council (PILP)	7.0	9.8	12.7*
Cooperative Projects with Industry (COPI)	2.1	2.1	-
Agriculture	0.4	0.4	-
Communications	0.4	0.4	-
Energy Mines & Resources	0.4	0.4	-
Environment	0.4	0.4	-
Fisheries and Oceans	0.4	0.4	-
R&D Grants & Contributions (TOTAL)	115.9	138.9	165.3
Communications	9.5	11.2	4.0
Energy Mines and Resources	2.9	15.1	18.4
Industry Trade and Commerce	74.0	85.6	110.5
National Research Council	25.6	22.4	27.4
Natural Sciences and Engineering Research Council (Industrial Research Fellowships)	1.5	2.3	2.7
Others	2.3	2.4	2.3
RSA Grants and Contracts (TOTAL)	55.4	63.8	72.0
Energy Mines & Resources	3.6	4.6	4.6
Atomic Energy of Canada Ltd	10.0	11.6	13.9
Environment	2.0	2.4	2.8
Fisheries and Oceans	2.0	2.0	3.4
Canadian International Development Agency	22.3	22.8	25.5
Transport	3.2	3.3	3.1
Others	12.3	17.1	18.7

* The two programs will be combined in 1981/82

Major expenditures occur under the industry support programs of the Department of Industry, Trade and Commerce which is the largest funder of government supported S&T activities in the industry sector. Increased expenditures of \$24.9 million to \$110.7 million in 1981/82 are estimated for departmental payments to industry. The Enterprise Development program is a multi-purpose program incorporating several of the department's former programs. One of the broad range of industrial development tools comprising this program is support for introduction of new or improved products and processes which have the potential for profitable commercial exploitation. Companies in Canada which can demonstrate the need for financial assistance and the capability to pursue successful R&D projects are eligible for cost-shared assistance for process and product innovation and market research. Eligibility is generally limited to small and medium sized businesses engaged in manufacturing or processing operations prepared to undertake relatively high risk projects which promise attractive rates of return and good prospects of success.

TABLE 13

Federal S&T Expenditures under Selected Industrial Support Programs

	1979/80	1980/81	1981/82
	(millions of dollars)		
Agriculture			
Production, Distribution Retailing (PDR)	0.8	0.9	0.9
Environment			
Energy from Forests (ENFOR)	4.2	4.4	6.4
Industry Trade and Commerce			
Defence Industry Productivity (DIPP)	31.3	36.7	39.3
Enterprise Development (EDP)	30.4	47.0	69.4
Industrial Energy R&D (IERD)	1.0	1.5	1.5
National Research Council			
Industrial Research Assistance (IRAP)	19.5	21.6	22.8
Industry/Laboratory Projects & Cooperative Projects with Industry (PILP & COPI)	9.1	11.7	12.7
Technical Information Service (TIS)	2.6	2.8	3.3
Supply and Services			
Unsolicited Proposals	14.9	15.0	15.1

Other major funders of industrial S&T are the Department of National Defence with 1980/81 estimated expenditures of \$34.6 million, the Department of Energy Mines and Resources with \$34.9 million, the Canadian International Development Agency with \$25.5 million and the Department of Communications with \$14.2 million. Of the \$7.9 million or 29% increase over 1980/81 in industrial S&T expenditures by the Department of Energy, Mines and Resources, \$6.2 million occurs in the Energy Program, in part in the form of contributions to stimulate the forest industry to greater use of forest biomass as a substitute source of energy.

Implementation of the policy to strengthen interfaces between the government, industry and university sectors is proceeding. During 1978, the government announced its intentions to fund university-based industrial research and innovation centres to aid industry, particularly small businesses and private inventors, in the development of new products or technologies. As a result, the establishment of two industrial innovation centres, one at the University of Waterloo and the other at Ecole Polytechnique de Montreal, has been approved in principal. By mid August, 1980, business plans had been completed by both universities and the centres are scheduled to begin their operations in 1981.

The Department of Energy, Mines and Resources established an Advisory Committee on Industrial Benefits which, with provincial input, has been reviewing major capital projects in the energy development field with the objective of obtaining maximum Canadian industrial participation.

Federal Science Activities in Provinces

Federal-provincial interaction in science and technology arises in three ways:

1. Federal direct payments to provinces for various S&T activities.
2. Joint Federal-Provincial S&T programs.
3. Federal government undertakes S&T activities in which the provinces have an interest.

Over the five-year period, Science and Technology payments to the provincial and municipal governments (Mainly Provincial) show a remarkable 3.5-fold increase (Table 10,11), with a 230% jump from 1978/79 to 1979/80 and increases of 22% for 1980/81 and 33% for 1981/82. The increases arise mainly from payments under the Canada-Albera Heritage Fund agreement, the

Canada-Saskatchewan heavy oil agreement and the program of joint federal-provincial projects in energy conservation and renewable energy resources.

Table 14 details the Federal Department's expenditures in the provincial sector in the last 3 years.

TABLE 14

Federal Science Expenditures in the Provincial Sector

	1979/80	1980/81	1981/82
	(millions of dollars)		
TOTAL	68.8	84.1	111.7
Energy, Mines & Resources	54.7	67.7	89.7
Environment	3.5	3.5	4.3
National Health and Welfare	1.5	1.9	2.4
Regional Economic Expansion	1.9	3.2	6.6
National Museums	6.4	5.6	5.9
Others	0.8	2.2	2.8

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