INVESTING IN CANADA'S FUTURE

Strengthening the Foundations of Canadian Research

CANADA'S FUNDAMENTAL SCIENCE REVIEW

RECOMMENDATION 1.1

- Consistent with the recommendation by the Advisory Council on Economic Growth, the Government of Canada should undertake a wide-ranging and multi-departmental review of innovation-related programming, including both direct and indirect supports for business research and development.

RECOMMENDATION 4.1

- The Government of Canada, by an Act of Parliament, should create a new National Advisory Council on Research and Innovation (NACRI) to provide broad oversight of the federal research and innovation ecosystems.

RECOMMENDATION 4.2

- The Science, Technology and Innovation Council should be wound down as NACRI is established.

RECOMMENDATION 4.3

- NACRI should have 12 to 15 members, appointed through Orders in Council, comprising distinguished scientists and scholars from a range of disciplines as well as seasoned innovators with strong leadership and public service records from the business realm and civil society. Domestic members should be drawn from across Canada and reflect the nation's diversity and regions.

RECOMMENDATION 4.4

- An external member should hold the Chair of NACRI with the CSA serving as Vice Chair. NACRI should be supported by a dedicated secretariat working within the larger expert team supporting the CSA.

RECOMMENDATION 4.5

- The Privy Council Office, working with departmental officials and the newly appointed CSA, should examine mechanisms to achieve improved whole-of-government coordination and collaboration for intramural research and evidence-based policy-making.

RECOMMENDATION 4.6

- As a council of senior volunteers with a broad mandate of national importance, NACRI should have a publicly acknowledged working connection to the Prime Minister/PMO, parallel to that established for the CSA. NACRI should report to and interact most directly with both the Minister of Science and the Minister responsible for Innovation and Economic Development. It should also have open channels of communication with the Minister of Health and other ministers of key departments involved in intramural and extramural research.

RECOMMENDATION 4.7

- A Special Standing Committee on Major Research Facilities should be convened by the CSA and report regularly to NACRI. The committee would advise NACRI and the Government of Canada on coordination and oversight for the life cycle of federally supported MRFs.

RECOMMENDATION 4.8

- Ongoing interactions and annual in-person meetings should be established to strengthen collaborative research relationships among federal, provincial, and territorial departments with major intramural or extramural research commitments. The CSA, with advice from NACRI, should take the lead in promoting a shared agenda on matters of national concern, such as human resource planning to strengthen research and innovation across Canada.

RECOMMENDATION 4.9

- The Government of Canada should propose and initiate planning for a First Ministers' Conference on Research Excellence in 2017. The conference would celebrate and cement a shared commitment to global leadership in science and scholarly inquiry as part of Canada's sesquicentennial celebrations.

RECOMMENDATION 4.10

- The Ministers of Science and Health should mandate the formation of a formal coordinating board for CFI, CIHR, SSHRC, and NSERC, chaired by the CSA. The membership of the new Four Agency Coordinating Board would include the four agency heads, departmental officials, and external experts. Reporting to the Ministers of Science and Health, the Coordinating Board would expeditiously determine and implement avenues for harmonization, collaboration, and coordination of programs, peer review procedures, and administration.

RECOMMENDATION 4.11

- The Government of Canada should undertake a comprehensive review to modernize and, where possible, harmonize the legislation for the four agencies that support extramural research. The review would clarify accountabilities and selection processes for agency governing bodies and presidents, promote good governance and exemplary peer review practices, and give priority to inter-agency collaboration and coordination.

RECOMMENDATION 5.1

- NACRI should be asked to review the current allocation of funding across the granting councils. It should recommend changes that would allow the Government of Canada to maximize the ability of researchers across disciplines to carry out world-leading research. Particular attention should be paid to evidence that ongoing program changes have adversely affected the funding opportunities for scholars in the social sciences and humanities.

RECOMMENDATION 5.2

- The Government of Canada should direct the new Four Agency Coordinating Board to develop and harmonize funding strategies across the agencies, using a lifecycle approach that balances the needs and prospects of researchers at different stages of their careers.

RECOMMENDATION 5.3

- The new Four Agency Coordinating Board should create a mechanism for harmonization as well as continuous oversight and improvement of peer review practices across the three councils and CFI.

RECOMMENDATION 5.4

- The Four Agency Coordinating Board should develop consistent and coordinated policies to achieve better equity and diversity outcomes in the allocation of research funding while sustaining excellence as the key decision-making criterion. This priority intersects efforts to improve peer review practices and requires a multipronged approach.

RECOMMENDATION 5.5

- The federal ministers responsible should consider hard equity targets and quotas where persistent and unacceptable disparities exist, and agencies and institutions are clearly not meeting reasonable objectives.

RECOMMENDATION 5.6

- The four agencies should examine best practices in supporting early career researchers, augment their support of them consistently across disciplines, and track and report publicly on the outcomes.

RECOMMENDATION 5.7

- The three granting councils should collaborate in developing a comprehensive strategic plan to promote and provide long-term support for Indigenous research, with the goal of enhancing research and training by and with Indigenous researchers and communities. The plan should be guided by the Truth and Reconciliation Commission's recommendations on research as a key resource.

RECOMMENDATION 5.8

- NACRI should be mandated not only to review proposals to create new third-party delivery organizations, but also to assess ongoing activities of all existing third-party organizations that receive federal support. It should guide their formal periodic review processes and advise the Government of Canada on the continuation, modification, or termination of their contribution agreements.

RECOMMENDATION 5.9

- When the intent is to support independent research, requirements for matching funds should be used sparingly and in a coordinated and targeted manner. In general, matching requirements should be limited to those situations where the co-funder derives a tangible benefit.

RECOMMENDATION 6.1

- The Government of Canada should rapidly increase its investment in independent investigator-led research to redress the imbalance caused by differential investments favouring priority-driven research over the past decade.

RECOMMENDATION 6.2

- The Government of Canada should direct the Four Agency Coordinating Board to amend the terms of the NCE program so as to include the fostering of collaborative multi-centre strength in basic research in all disciplines.

RECOMMENDATION 6.3

- The Government of Canada should direct the granting councils to undertake an interim evaluation of the CFREF program before the third wave of awards is made. The CSA and NACRI should be engaged in the design of the review. The results would guide a decision on whether to launch or defer the program's third round, but not impede the fulfilment of existing commitments.

RECOMMENDATION 6.4

- The Government of Canada should mandate the Four Agency Coordinating Board to develop multi-agency strategies to support international research collaborations and modify existing funding programs so as to strengthen international partnerships.

RECOMMENDATION 6.5

- The Government of Canada should mandate the Four Agency Coordinating Board to develop strategies to encourage, facilitate, evaluate, and support multidisciplinary research.

RECOMMENDATION 6.6

- The Government of Canada should mandate the granting councils to encourage and better support high-risk research with the potential for high impact.

RECOMMENDATION 6.7

- The Government of Canada should mandate the granting councils to arrive at a joint mechanism to ensure that funds and rapid review mechanisms are available for response to fast-breaking issues.

RECOMMENDATION 6.8

- The Government of Canada should provide CFI with a stable annual budget scaled at minimum to its recent annual outlays.

RECOMMENDATION 6.9

- The Government of Canada should consolidate the organizations that provide digital research infrastructure, starting with a merger of Compute Canada and CANARIE. It should provide the new organization with long-term funding and a mandate to lead in developing a national DRI strategy.

RECOMMENDATION 6.10

- The Government of Canada should mandate and fund CFI to increase its share of the matching ratio for national-scale major research facilities from 40 to 60 per cent.

RECOMMENDATION 6.11

- The Government of Canada should mandate and fund CFI to meet the special operating needs of individual researchers with small capital awards.

RECOMMENDATION 7.1

- The Government of Canada should direct the Four Agency Coordinating Board to oversee a tri-council process to reinvigorate and harmonize scholarship and fellowship programs, and rationalize and optimize the use of current awards to attract international talent.

RECOMMENDATION 7.2

- The Government of Canada should renew the CRC program on a strategic basis in three stages:

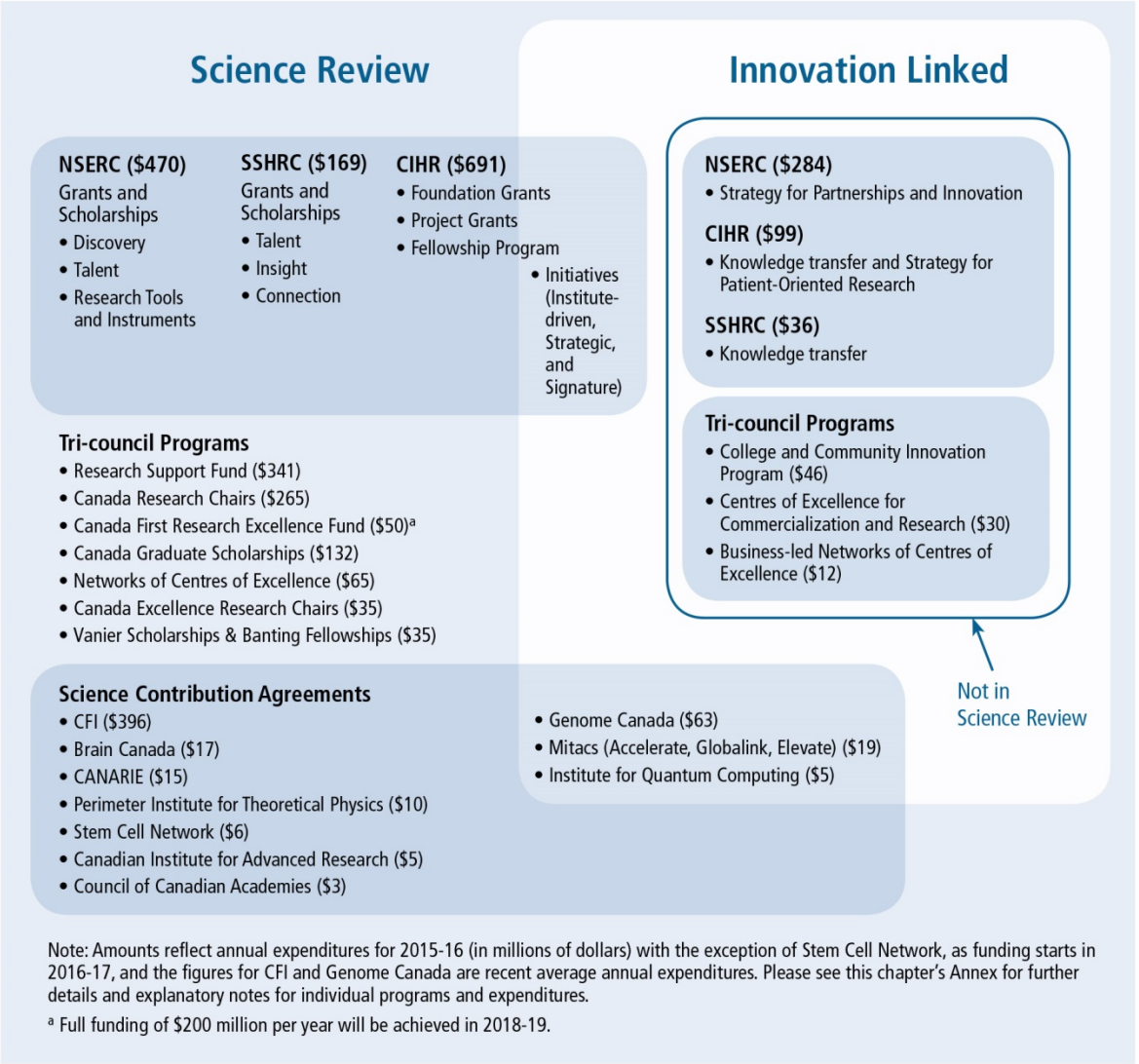
1. Restore funding to 2012 levels, upon development of a plan by the granting councils and Chairs Secretariat to allocate the new Chairs asymmetrically in favour of Tier 2 Chairs, and increase the uptake of available funds through improved logistics in managing numbers and reduced delays in awarding Chairs;
2. Direct the granting councils to cap the number of renewals of Tier 1 Chairs and, in concert with universities and CFI, develop a plan to reinvigorate international recruitment and retention, for review by NACRI and approval by the government; and
3. On approval of that plan, adjust the value of the CRCs to account for their loss in value due to inflation since 2000.

RECOMMENDATION 7.3

- The Government of Canada should gradually increase funding to the RSF until the reimbursement rate is 40 per cent for all institutions with more than $7 million per year of eligible funding. Current thresholds should be maintained to enable additional support for smaller institutions. As the size of the envelope of RSF-eligible operating grants grows, the funding of the RSF should be increased in lock-step to sustain the reimbursement rate of F&A costs on a trajectory towards this 40 per cent goal.

1.2

Exhibit 1.2: Canada's Science and Innovation Ecosystem

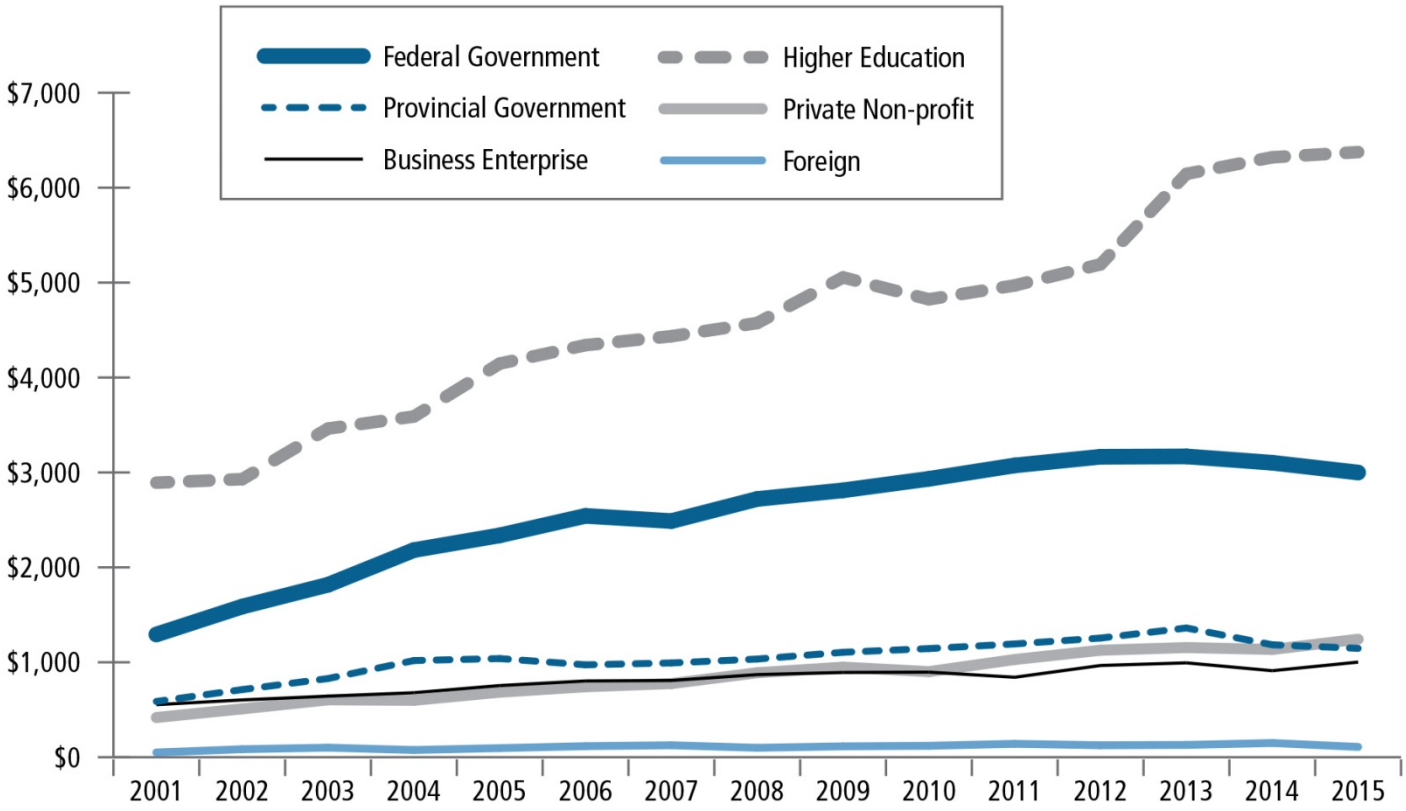


Note: Amounts reflect annual expenditures for 2015-16 (in millions of dollars) with the exception of Stem Cell Network, as funding starts in 2016-17, and the figures for CFI and Genome Canada are recent average annual expenditures. Please see this chapter's Annex for further details and explanatory notes for individual programs and expenditures.

[a] Full funding of $200 million per year will be achieved in 2018-19.

3.3

Exhibit 3.3: Sources of R&D Funding to the Higher Education Sector, by Funding Sector, 2001 to 2015 ($ Millions)



Source: Statistics Canada, CANSIM table 358-0162.

3.4

Exhibit 3.4: Top 20 Countries by Number of Scientific Publications Produced

Rank (2009–2014)	Country	Number of Publications		Share of World Publications (%)		CI		GI	GR
		2009–2014	2003–2008	2009–2014	2003–2008	2009–2014	2003–2008	2003–2014	
1	United States	3,136,910	2,633,098	24.3	29.2	1.00	0.89	0.80	1.15
2	China	2,600,858	1,207,471	20.1	13.4	0.48	0.46	1.50	2.15
3	United Kingdom	869,569	682,941	6.7	7.6	1.39	1.26	0.83	1.19
4	Germany	837,314	651,436	6.5	7.2	1.34	1.29	0.86	1.23
5	Japan	728,582	685,686	5.6	7.6	0.68	0.65	0.72	1.04
6	France	611,138	479,262	4.7	5.3	1.35	1.27	0.84	1.21
7	India	545,655	246,898	4.2	2.7	0.46	0.51	1.56	2.24
8	Italy	499,039	364,427	3.9	4.0	1.13	1.06	0.92	1.31
9	Canada	496,696	377,779	3.8	4.2	1.26	1.20	0.88	1.26
10	Spain	431,204	281,290	3.3	3.1	1.14	1.01	1.01	1.46
11	Australia	398,375	252,189	3.1	2.8	1.22	1.09	1.03	1.49
12	Republic of Korea	388,387	234,694	3.0	2.6	0.69	0.71	1.15	1.64
13	Brazil	321,960	177,451	2.5	2.0	0.65	0.71	1.28	1.84
14	Netherlands	280,459	201,344	2.2	2.2	1.37	1.28	0.91	1.30
15	Russia	256,825	208,439	2.0	2.3	0.74	0.91	0.89	1.27
16	Iran	211,646	63,321	1.6	0.7	0.46	0.49	2.37	3.41
17	Switzerland	207,018	146,791	1.6	1.6	1.59	1.53	0.91	1.31
18	Turkey	199,421	122,841	1.5	1.4	0.45	0.42	1.11	1.60
19	Poland	194,570	140,014	1.5	1.6	0.72	0.81	0.98	1.41
20	Sweden	180,825	137,728	1.4	1.5	1.38	1.28	0.83	1.19
	World	12,935,138	9,006,984	100	100			1.00	1.44

Data Source: Calculated by Science-Metrix using Scopus database (Elsevier)

3.5

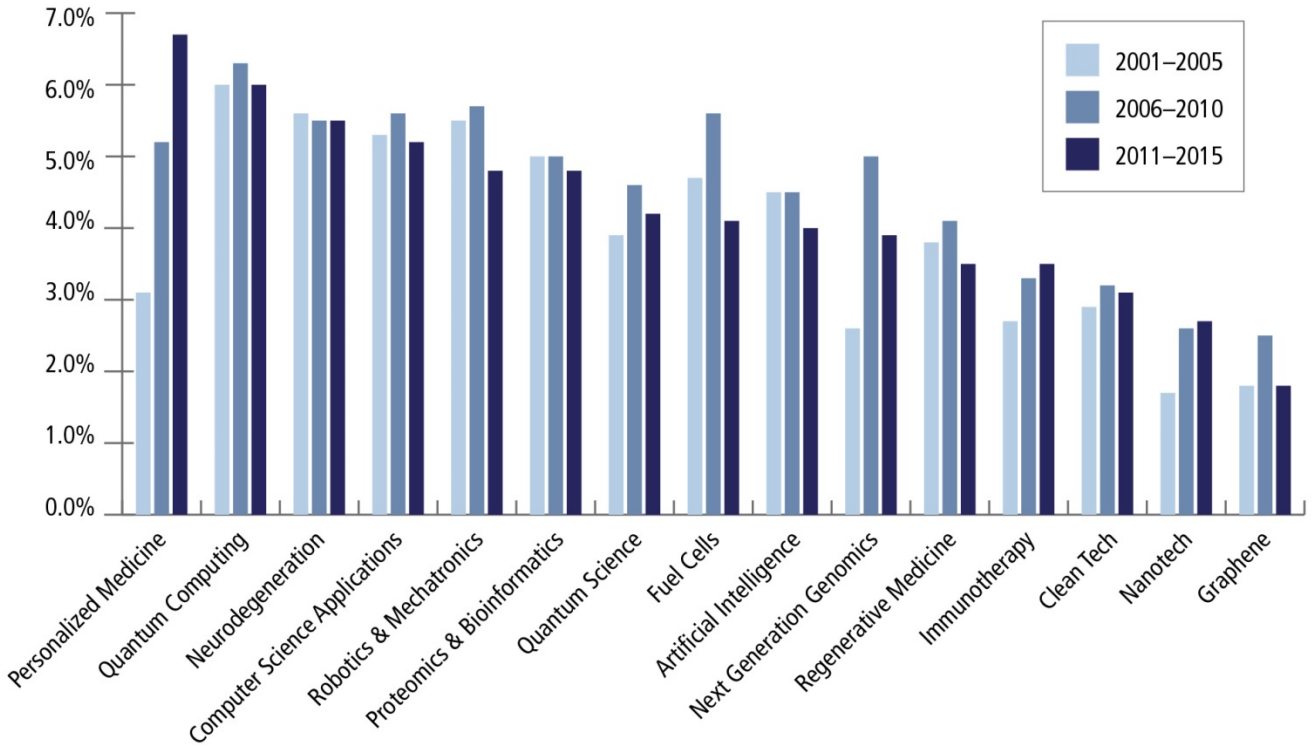
Exhibit 3.5: Interprovincial and International Collaboration Rates by Canadian Province and Territory, 2003 to 2014

Province	Collaboration Rates	
	Interprovincial	International
Alberta	24.5	42.5
British Columbia	23.0	48.2
Manitoba	33.5	39.7
New Brunswick	35.7	38.0
Newfoundland and Labrador	33.6	38.7
Northwest Territories	86.9	32.5
Nova Scotia	34.7	40.9
Nunavut	85.7	34.5
Ontario	14.8	43.4
Prince Edward Island	46.7	40.6
Quebec	16.9	43.8
Saskatchewan	33.9	41.7
Yukon	79.4	39.0
Canada	9.8	43.7

Source: The Expert Panel on the State of Science and Technology and Industrial Research and Development in Canada. Preliminary Data Update on Canadian Research Performance and International Reputation. Ottawa: Council of Canadian Academies; 2016. Available from: http://www.scienceadvice.ca/uploads/eng/assessmentspublicationsnewsreleases/stird2016/st_interimdataupdate_en_web.pdf

3.6

Exhibit 3.6: Canada's Share of Global Publications in Emerging Research Areas



Source: Clarivate Analytics, Web of Science.

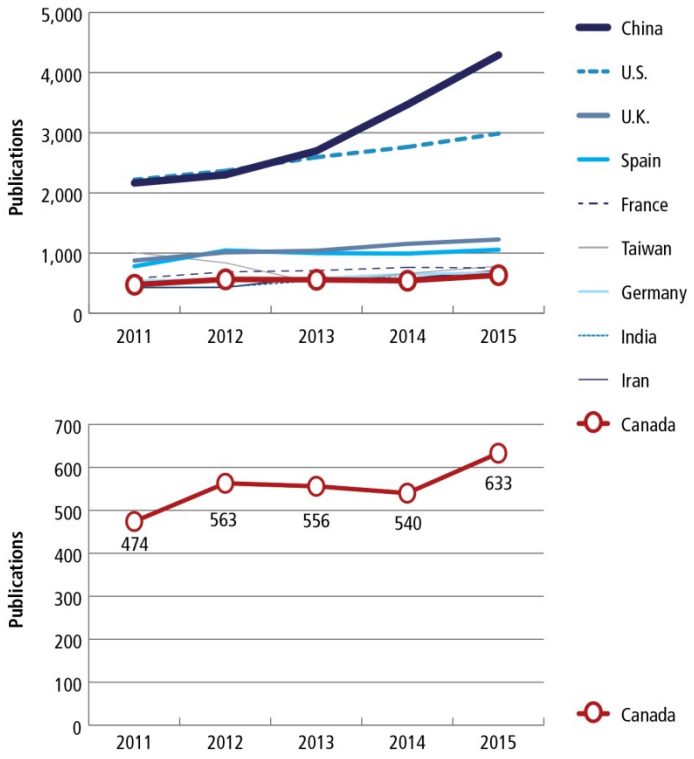
3.7

Exhibit 3.7: Bibliometric Analysis of Artificial Intelligence Research, 2011 to 2015

This data set includes all publications containing the terms *Artificial Intelligence, Machine Learning* and *Neural Networks* (only when relevant to non-biological systems), combined with all articles from journals relating to Artificial Intelligence (as defined by the Web of Science subject category). This hybrid search strategy includes research into the field of artificial intelligence and research topics that utilize artificial intelligence techniques.

Key performance indicators:

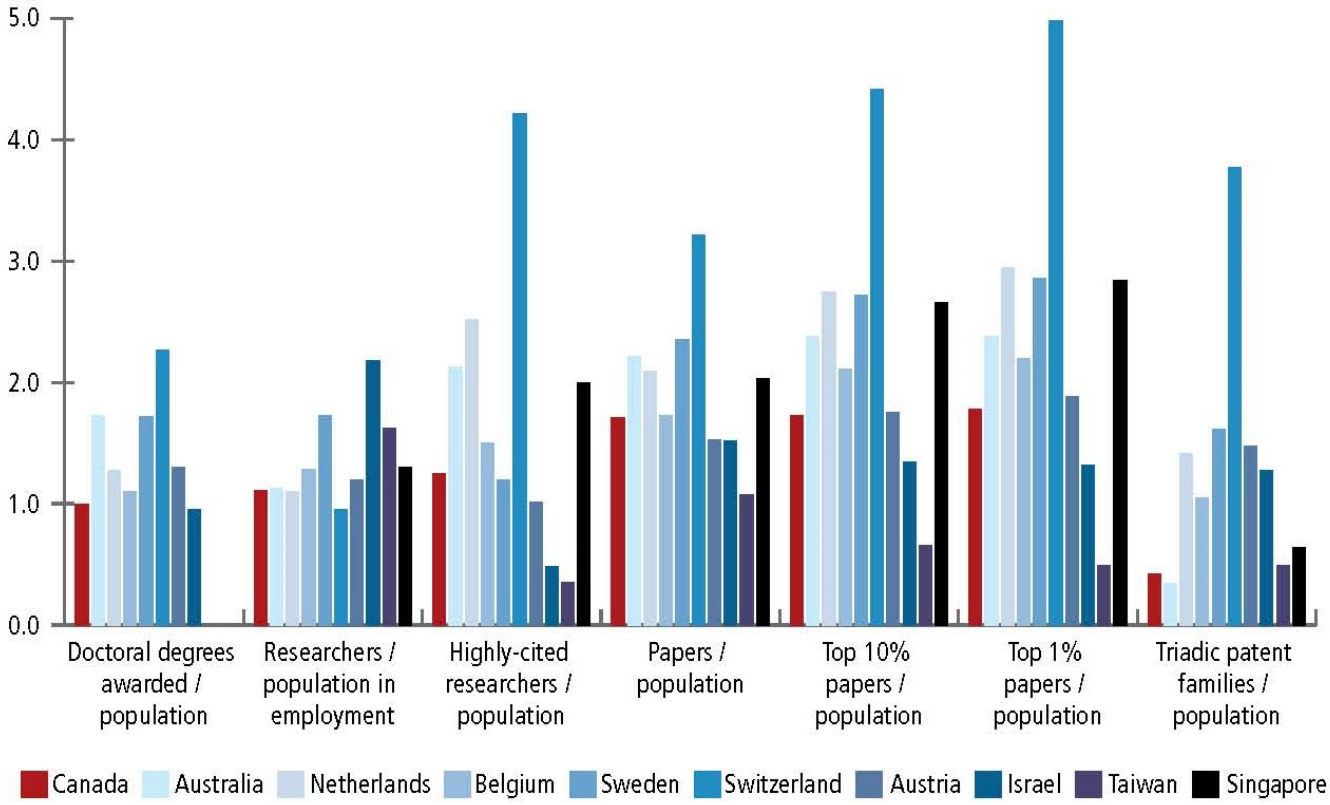
Countries	Publications	Citations	Citations / Publication	Top Cited Publications	International Collaboration
China	14,930	120,442	8.1	2,715	34%
U.S.	12,933	110,957	8.6	2,074	48%
U.K.	5,308	49,206	9.3	949	61%
Spain	4,872	33,524	6.9	700	47%
France	3,492	27,563	7.9	494	53%
Taiwan	3,790	24,460	6.5	476	16%
Germany	3,009	24,852	8.3	455	57%
India	2,724	17,434	6.4	332	24%
Iran	2,751	17,621	6.4	403	43%
Canada	2,766	21,446	7.8	401	52%
Italy	2,650	17,074	6.4	359	51%
Australia	2,303	22,754	9.9	376	46%
Korea	2,201	12,580	5.7	253	36%
Turkey	2,120	13,789	6.5	259	22%
Japan	2,006	10,592	5.3	171	45%
Hong Kong	1,821	19,316	10.6	377	37%
Singapore	1,457	17,963	12.3	330	70%
Netherlands	1,304	10,897	8.4	204	49%
Brazil	1,270	6,504	5.1	141	32%
Poland	1,123	6,211	5.5	152	47%



Note: Data from Web of Science/InCites, provided by Clarivate Analytics. See Annex A of Appendix 4 for data sources, methodology and indicator definitions, and Annex B of Appendix 4 for keywords and search syntax.

Exhibit 3.8: Research Capacity, Activity, and Output (Normalized to OECD Averages)

B. Canada as compared to smaller peer countries



Note: In most cases the data are from 2013; please see this chapter's Annex for details and values. Data on doctoral degrees awarded not available for China, Taiwan, or Singapore. Bibliometric data are from Clarivate Analytics, InCites; see this chapter's Annex for full list of sources. Data are normalized relative to the OECD averages, which are set to 1.0.

4.1

Exhibit 4.1: Science Advice: Canadian Institutional and Governmental Sources of Science Advice over Time

Time Period	Sources of Science Advice
1882–	Royal Society of Canada
1916–	National Research Council (Honorary Advisory Council on Scientific and Industrial Research)
1964–1971	Science Secretariat of the Privy Council Office
1964–1992	Science Council of Canada
1987–1996	National Advisory Board on Science and Technology
1988–1993	National Forum of Science and Technology Councils
1996–2007	Advisory Council on Science and Technology
1996–2007	Council of Science and Technology Advisors
2003–2008	National Science Advisor to the Prime Minister
2005–	Council of Canadian Academies (formerly Canadian Academies of Science)
2007–	Science, Technology and Innovation Council
2017–	Chief Science Advisor, Government of Canada

Exhibit 4.3: Federal Science, Technology, and Innovation Priorities, 2014

Research Priorities	Focus Areas
Environment and Agriculture	Water: Health, Energy, Security Biotechnology Aquaculture Sustainable methods of accessing energy and mineral resources from unconventional sources Food and food systems Climate change research and technology Disaster mitigation
Health and Life Sciences	Neuroscience and mental health Regenerative medicine Health in an aging population Biomedical engineering and medical technologies
Natural Resources and Energy	Arctic: Responsible development and monitoring Bioenergy, fuel cells, and nuclear energy Bio-products Pipeline safety
Information and Communications Technologies	New media, animation, and games Communications networks and services Cybersecurity Advanced data management and analysis Machine-to-machine systems Quantum computing
Advanced Manufacturing	Automation (including robotics) Lightweight materials and technologies Additive manufacturing Quantum materials Nanotechnology Aerospace Automotive

4.4

Exhibit 4.4: Summary of Mandate of the Chief Science Advisor (CSA)

Reporting and Office

- Reports to both Prime Minister and Minister of Science on government-wide scientific matters
- Office of CSA within Innovation, Science and Economic Development (ISED)

Mandate

- Examine the role and function of existing science advisory bodies across government;
- Assess the merits of a network of departmental Chief Science Advisors, with a decision based on this advice to follow;
- Play a primarily advisory and coordinating role, not a governance and decision-making role;
- Advise on the development and implementation of guidelines so that government science is fully available to the public, and scientists are free to speak about their work;
- Provide advice and implement processes so that scientific analyses are considered when government makes decisions;
- Assess and recommend ways for government to better support quality scientific research within the federal system;
- Provide annual reports on the state of federal government science;
- Provide expert advice to Minister of Science and Cabinet as requested on key scientific issues, including research and foresight papers for public dissemination; and
- Promote a dialogue between federal scientists and academia, in Canada and abroad, and raise awareness of scientific issues among the Canadian public.

Source: Compiled by the secretariat based on information from ISED.

4.5

Exhibit 4.5: Characteristics of Major Granting Council Programs Supporting Investigator-led Research

	Program Name	Applications (per year)[a]	Grants Awarded (per year)[a]	Success Rate[a]	Active Grants[b]	Average Annual Grant Value[b]
SSHRC	Insight Development and Insight Grants	3,112	778	25.0%	2,529	$37,701
NSERC	Discovery Grants	3,214	2,039	63.4%	10,315	$34,876
CIHR	Open Operating Program, Foundation, and Project Grants	4,681	688	14.7%	3,468	$143,514

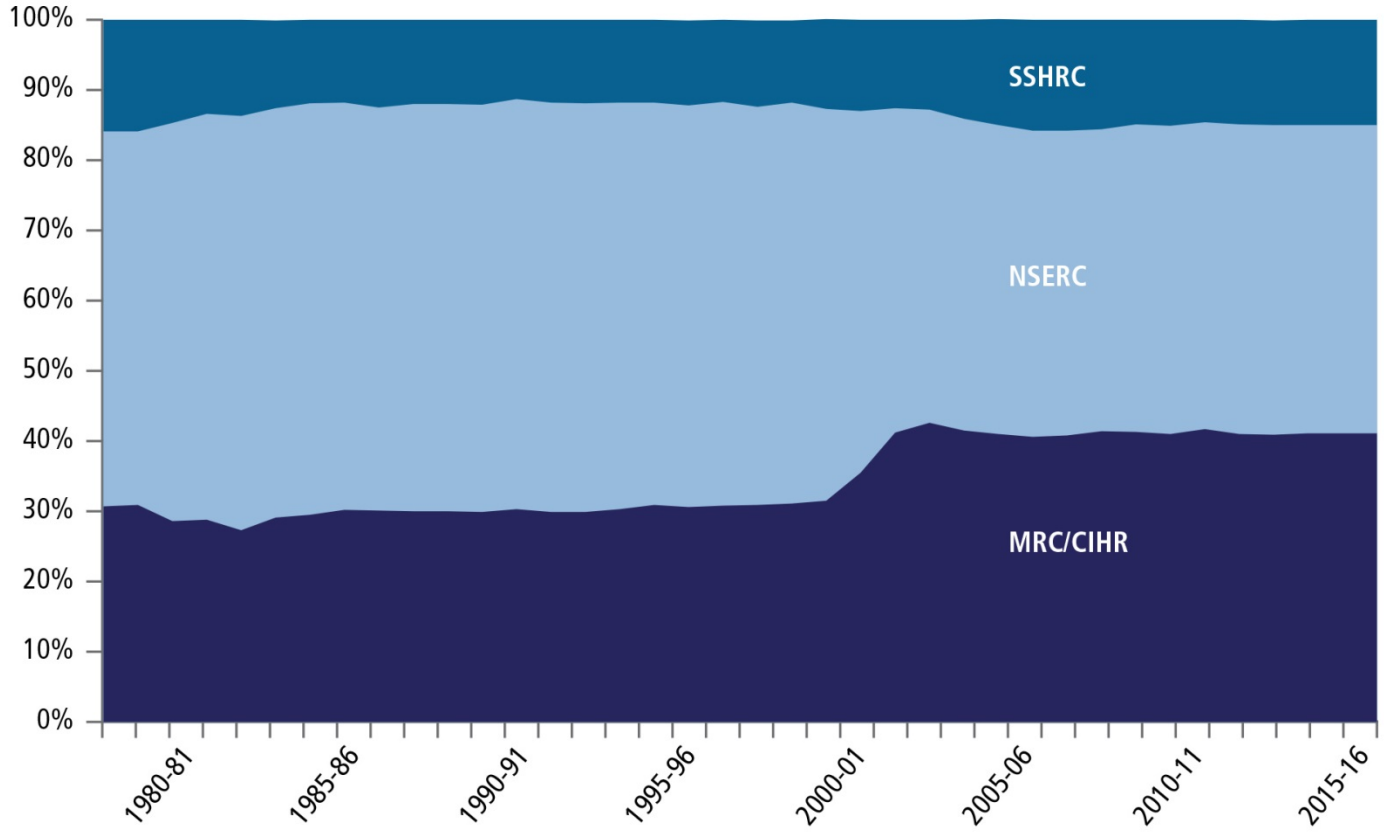
[a] Average of the four-year period 2012-13 to 2015-16.

[b] Data for 2015-16 only.

Source: Calculations by the secretariat based on detailed program expenditures provided by the granting councils.

5.1

Exhibit 5.1: Total Granting Council Expenditures by Council

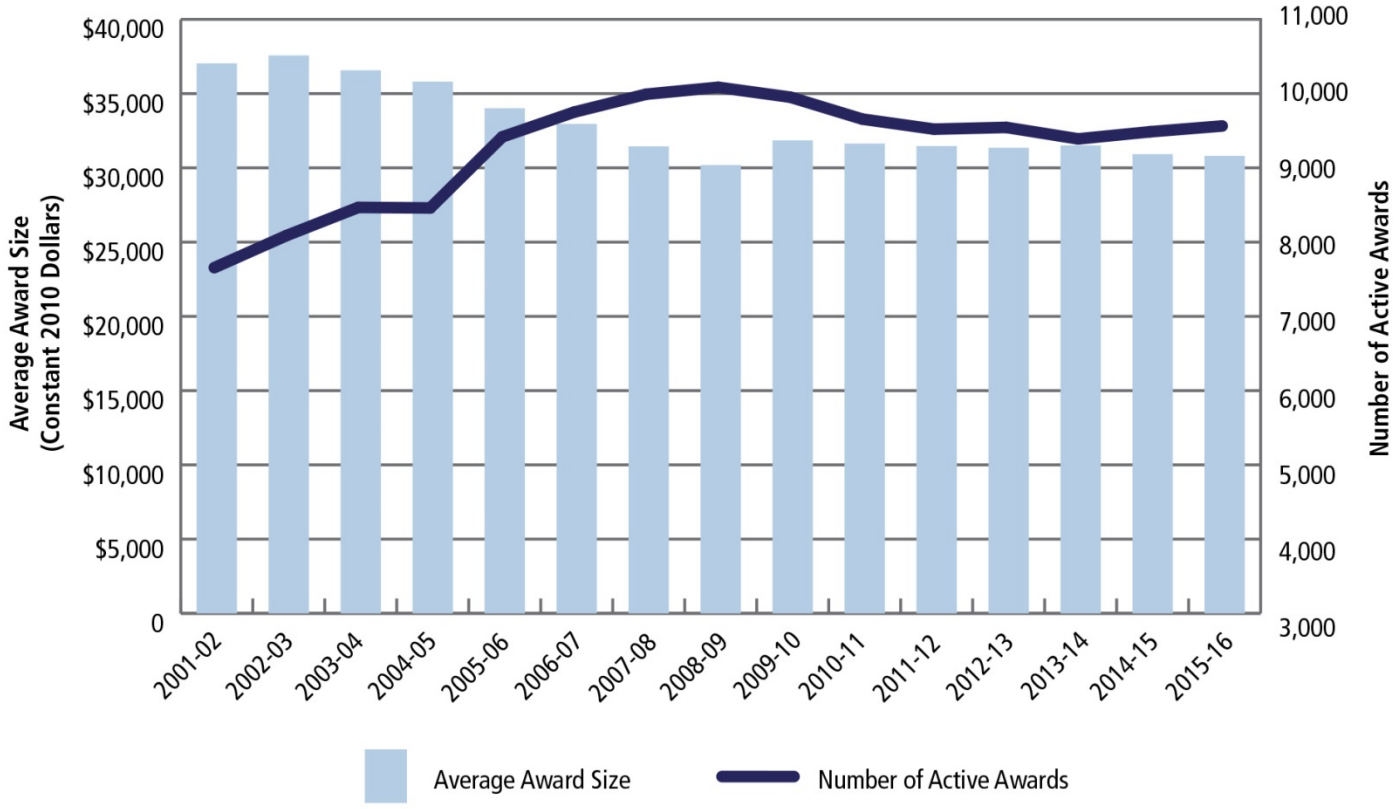


Note: Our analysis of research funding trends in this figure excludes the Research Support Fund (RSF)—previously the Indirect Costs Program (ICP)—since it does not support researchers directly. Rather, it provides funding directly to institutions to help defray the costs associated with managing research funded by the three granting councils (e.g., electricity and administrative support).

Source: ISED.

5.4

Exhibit 5.4: NSERC Discovery Grants Program – Individual, 2001-02 to 2015-16



Source: Compilations by the secretariat based on estimates from NSERC, October, 2016.

5.5

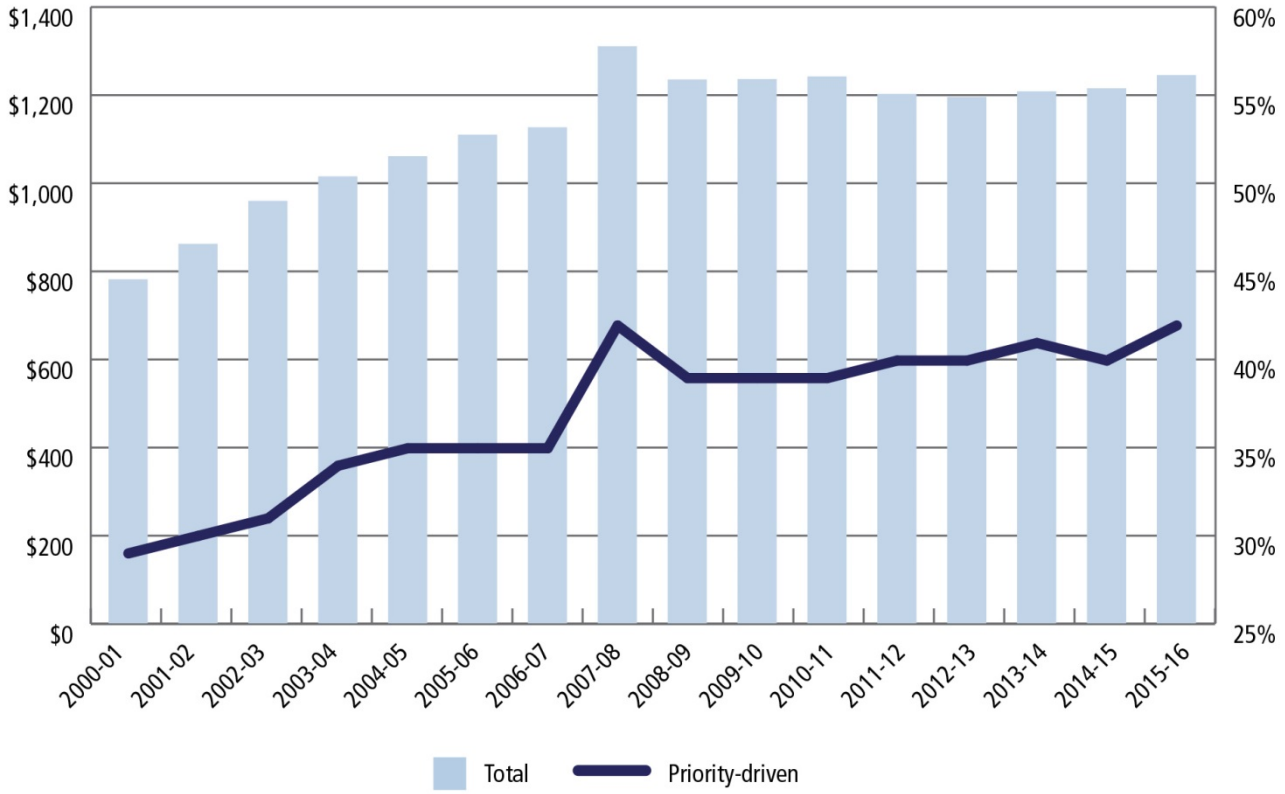
Exhibit 5.5: Distribution of Full-time University Academic Staff in Canada by Rank and Sex

Rank	Sex	1970	1980	1990	2000	2010
All Ranks Combined	Male	87.2%	85.4%	80.4%	72.0%	63.4%
	Female	12.8%	14.6%	19.6%	28.0%	36.6%
Full Professor	Male	96.6%	95.2%	92.4%	84.8%	76.6%
	Female	3.4%	4.8%	7.6%	15.2%	23.4%
Associate Professor	Male	91.9%	87.4%	80.5%	68.3%	61.7%
	Female	8.1%	12.6%	19.5%	31.7%	38.3%
Assistant Professor	Male	86.2%	76.5%	66.8%	58.8%	53.6%
	Female	13.8%	23.5%	33.2%	41.2%	46.4%
Other	Male	72.0%	64.8%	56.1%	48.5%	46.9%
	Female	28.0%	35.2%	43.9%	51.5%	53.1%

Source: Calculations by the secretariat based on Statistics Canada, CANSIM table 477-0017.

6.1

Exhibit 6.1: Overall Granting Council Research Funding, and Proportion for Priority-driven Research (Constant 2000 Dollars, $ Millions)

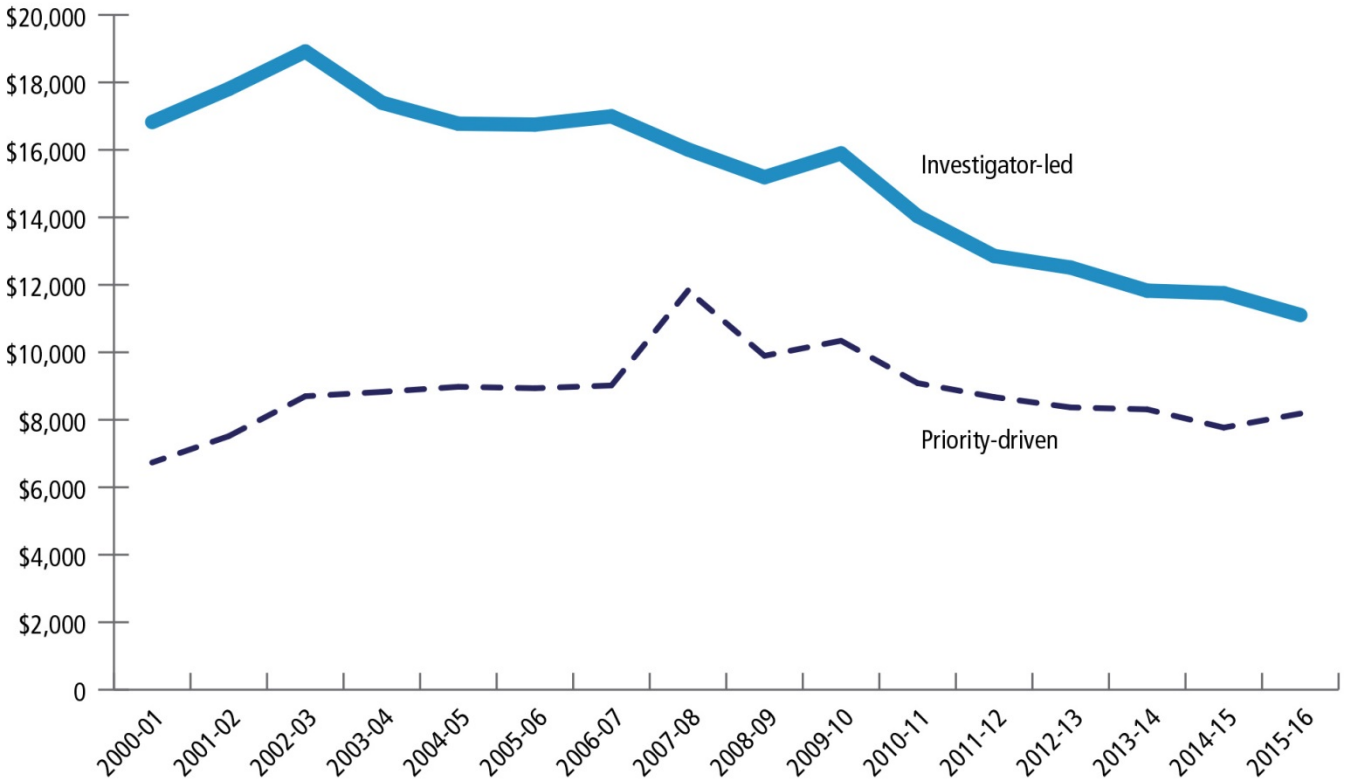


Note: Total research funding (left axis) is the sum of granting council expenditures on investigator-led and priority-driven research.

Source: Compilations from the secretariat based on data provided by the granting councils.

6.2

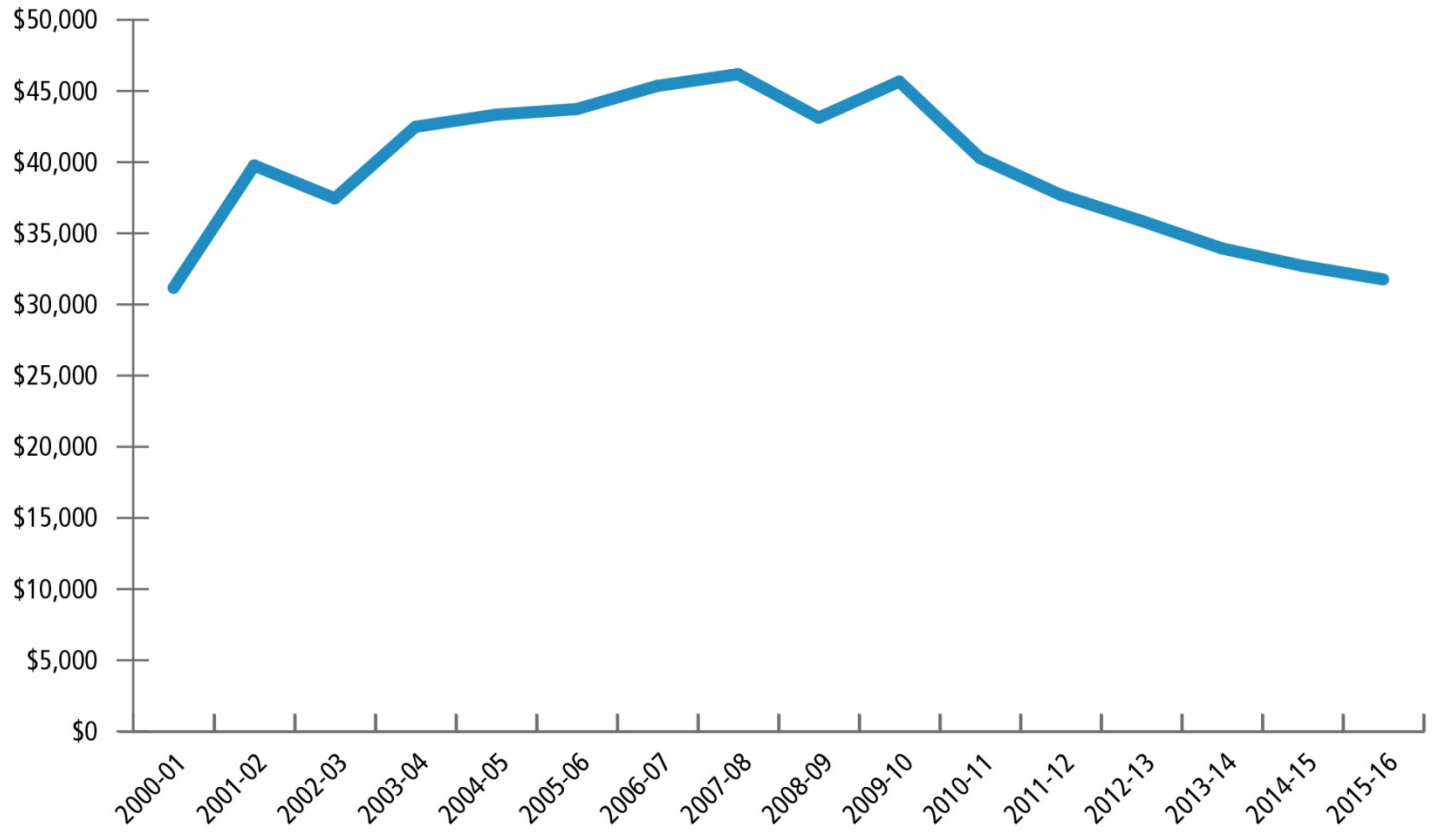
Exhibit 6.2: Granting Council Funding per Researcher for Investigator-led and Priority-driven Research (Constant 2000 Dollars)



Source: Compilations from the secretariat based on data provided by the granting councils. The number of researchers for 2014 to 2016 was extrapolated from prior year growth trends.

6.3

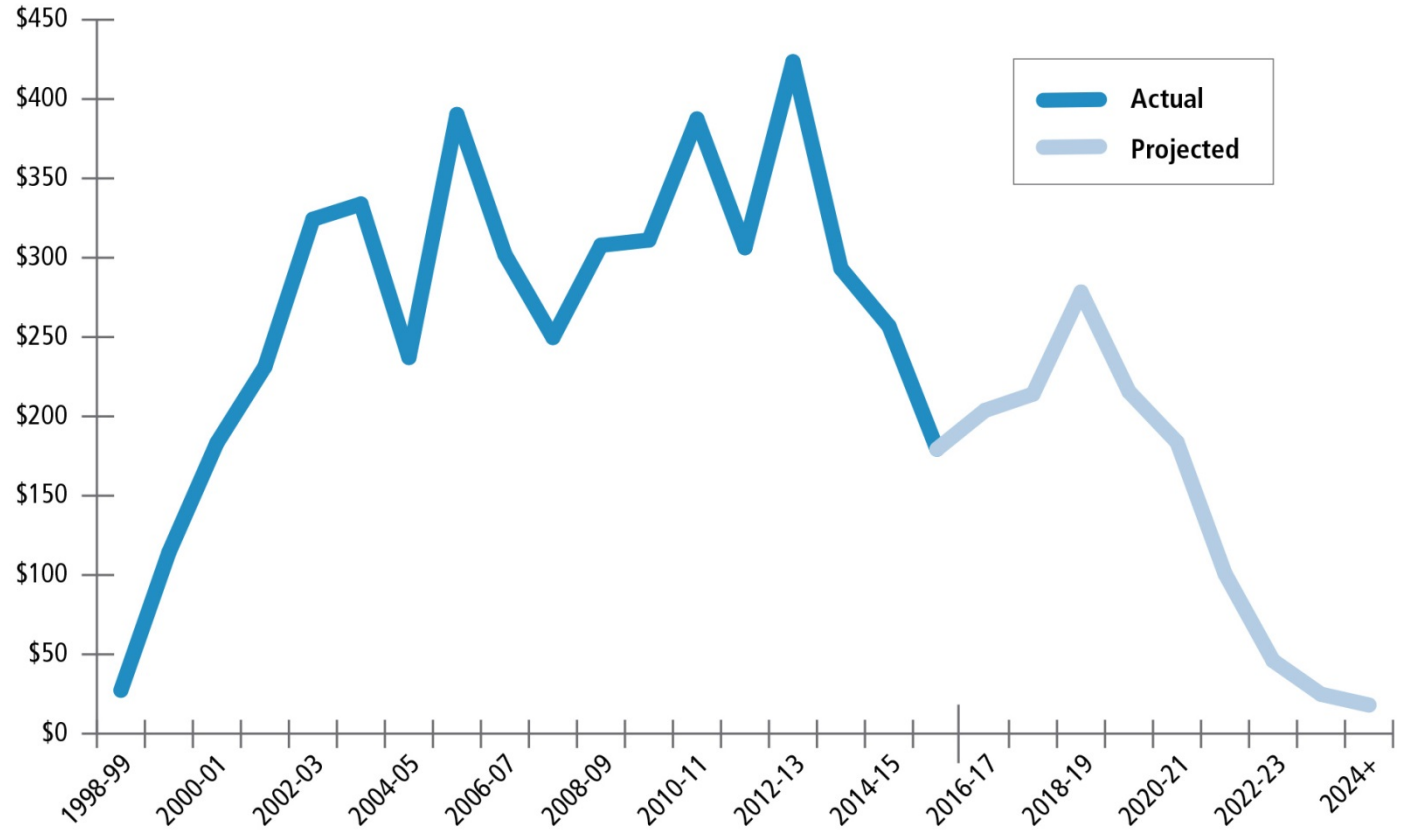
Exhibit 6.3: Total Granting Council Funding per Researcher (Constant 2000 Dollars)



Source: Compilations from the secretariat based on data provided by the granting councils. The number of researchers for 2014 to 2016 was extrapolated from prior year growth trends.

6.5

Exhibit 6.5: CFI Expenditures on Capital Programs ($ Millions)



Source: Compilations from the secretariat based on data provided by CFI.

6.6

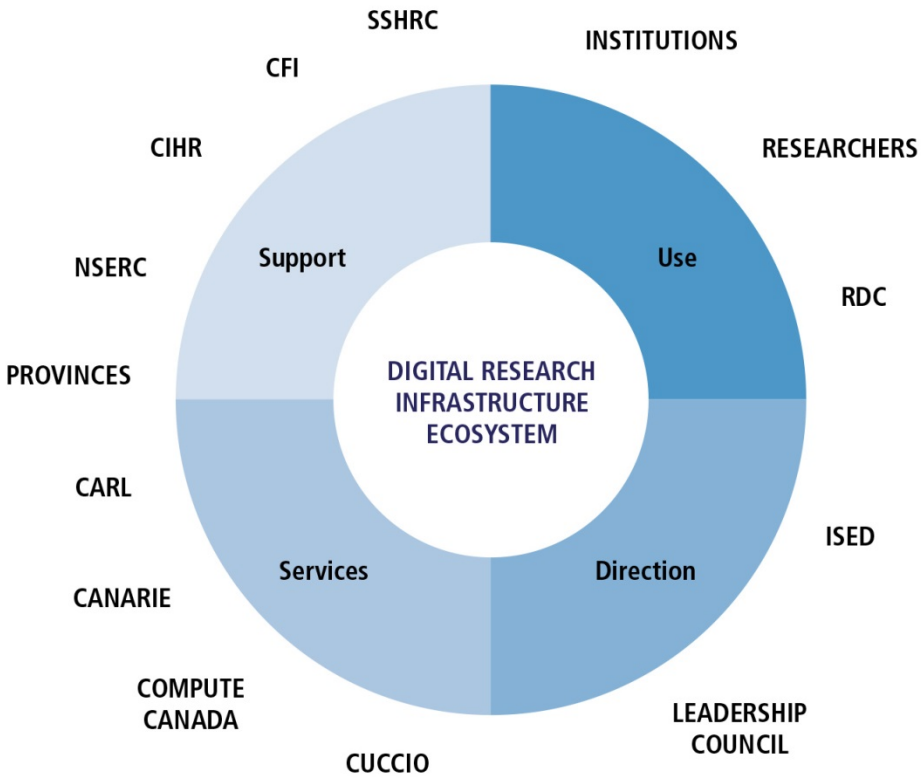
Exhibit 6.6: Comparison of Total Granting Council Expenditures and CFI Capital Expenditures ($ Millions)

	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	Average
Granting Councils	$2,258	$2,554	$2,550	$2,593	$2,656	$2,658	$2,632	$2,633	$2,684	$2,735	$2,595
CFI	$302	$250	$308	$311	$387	$306	$424	$293	$257	$179	$302
Ratio of CFI to Granting Councils	13.4%	9.8%	12.1%	12.0%	14.6%	11.5%	16.1%	11.1%	9.6%	6.5%	11.6%

Source: Compilations from the secretariat based on data provided by the granting councils and CFI.

6.7

Exhibit 6.7: Actors in the Canadian Digital Research Infrastructure Ecosystem



Note: CARL, Canadian Association of Research Libraries; CUCCIO, Canadian University Council of Chief Information Officers; RDC, Research Data Canada.

Source: Canada Foundation for Innovation. Developing a digital research infrastructure strategy for Canada: The CFI perspective. Ottawa: CFI; November 2015. Available from: https://www.innovation.ca/sites/default/files/Funds/cyber/developing-dri-strategy-canada-en.pdf

7.1

Exhibit 7.1: Comparison of Doctoral Scholarship Programs

Granting Council/ Program	Total # of Awards (per year)	Annual Value	Maximum Duration	Tenure
CGS-D	2,500 (833)	$35,000	3 years	Canada
CIHR	30 (10)	$35,000	3 years	Abroad
NSERC	~ 1,200 (400)	$21,000	3 years	Canada or Abroad
SSHRC	~ 2,000 (500)	$20,000	4 years	Canada or Abroad

Source: Compilations from the secretariat based on data provided by the granting councils.

7.2

Exhibit 7.2: Comparison of Postdoctoral Fellowship Programs

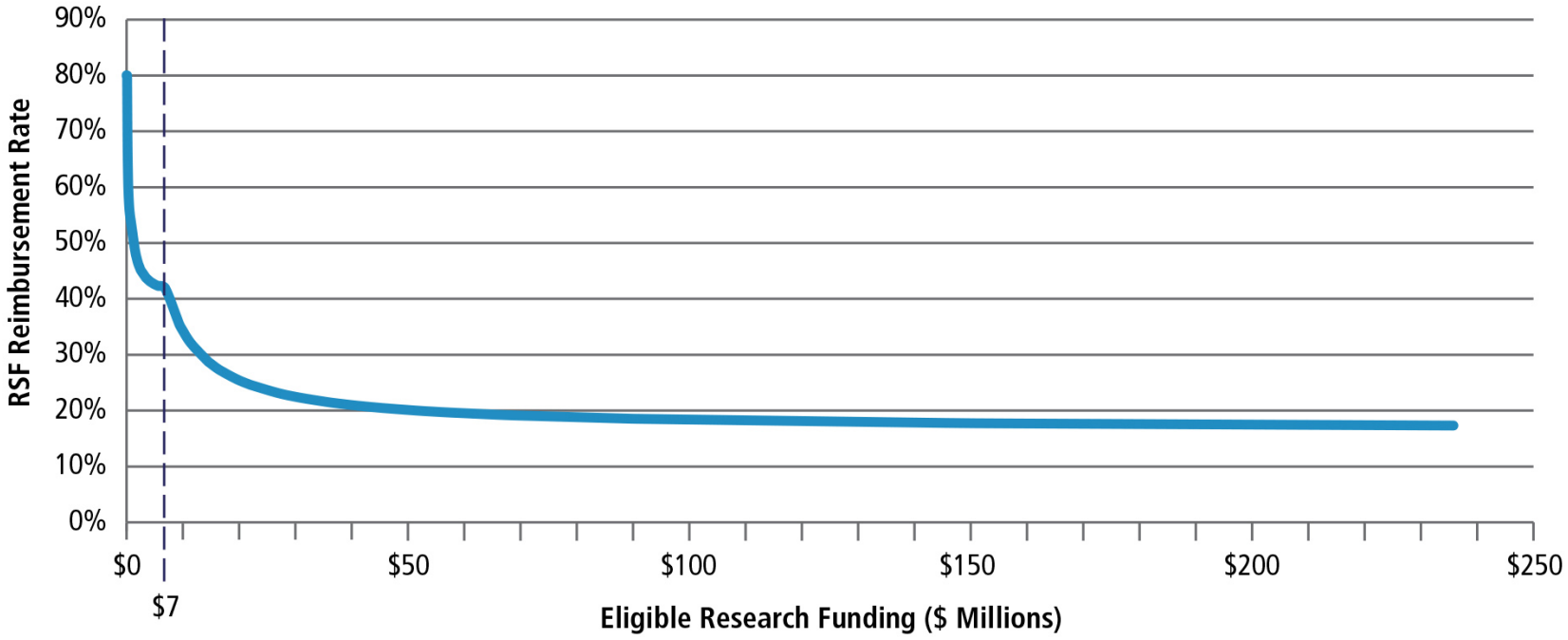
Granting Council	Total # of Awards (per year)	Annual Value	Maximum Duration	Citizenship	Tenure
CIHR	~ 600 (170)	$45,000 to $60,000[a]	3 to 5 years[a]	Canadians or foreigners	Canada or Abroad
NSERC	~ 360 (180)	$45,000	2 years	Canadian only	Canada or Abroad
SSHRC	~ 360 (180)	$40,500	2 years	Canadian only	Canada or Abroad

[a] Value and duration of awards varies depending on applicant's degree (PhD or health professionals) and tenure in Canada or abroad.

Source: Compilations from the secretariat based on data provided by the granting councils.

7.3

Exhibit 7.3: RSF Reimbursement Rate by Total Amount of Eligible Research Funding



Source: 2016-17 Research Support Fund Control Sheet, provided to the secretariat by the RSF Secretariat.

7.4

Exhibit 7.4: Proposed Increases to RSF Based on Current RSF Funding and on the Panel's Recommended Increase to Direct Project Funding ($ Millions)

	Year 1	Year 2	Year 3	Year 4
Current RSF-eligible Base of Direct Project Spending	1,708	1,708	1,708	1,708
Current RSF Funding	369	369	369	369
Increment to 25% Reimbursement	58	58	58	58
Increment to 30% Reimbursement	143	143	143	143
Increment to 35% Reimbursement	229	229	229	229
Increment to 40% Reimbursement	314	314	314	314
Panel's Recommended Direct Project Funding Increase	155	310	465	485
Increase to RSF at 21.6%[a]	33	37	70	75
Increase to RSF at 25%[a]	38	48	86	91
Increase to RSF at 30%[a]	47	63	110	116
Increase to RSF at 35%[a]	54	79	133	140
Increase to RSF at 40%[a]	62	94	156	164
Total Proposed RSF Increase	**96**	**206**	**362**	**478**

[a] Beginning in year 2, the amounts shown have been reduced by $30 million per year. This amount offsets the recommended increase in operating support for small capital awards delivered by CFI (see Recommendation 6.11).

7.5

Exhibit 7.5: A Four-year Plan to Renew Canadian Research ($ Millions)

	Year 1	Year 2	Year 3	Year 4
Investigator-led Direct Project Funding	135	270	405	405
Specialized Direct Project Funding	20	40	60	80
Total Direct Project Funding	155	310	465	485
Operating Funds for Major Research Facilities	35	35	35	35
Operating Funds for Small Capital Projects	30	30	30	30
Scholarships and Fellowships	35	70	105	140
Research Chairs for Excellent Scholars and Scientists	35	140	140	140
Facilities and Administration Costs (Research Support Fund)	96	206	362	478
Total	**386**	**791**	**1,137**	**1,308**

A1.1

Exhibit A1.1: Application and Adjudication Processes for Foundational Research Grants

	Discovery Grants (NSERC)	Insight Grants (SSHRC)	Foundation Grants (CIHR)
Competitions per Year	1	1	1
Success Rate	~60%	~23% (2015-16 competition)	~13% (2015-16 competition)
Time Between Application and Results	6-7 months	5-6 months	9-10 months
Application and Review Process	Notification of Intent (NOI) submitted prior to full application, which is reviewed in two steps: • External reviewers read applications and provide a written report. • Evaluation groups assess applications as a group, informed by the reports of external reviewers.	One application submitted and reviewed in two steps: • External assessors read applications and provide a written report. • Adjudication committees assess applications as a group, informed by the reports of external assessors.	Three stage process, with one application submitted in Stage 1 and another in Stage 2 for those successful in the previous stage: • Stage 1 application and review focus on the calibre of the applicant(s). Virtual expert review over the internet. Successful applicants invited to submit an application for the next stage. • Stage 2 application and review focus on the quality of the proposed research program. Virtual expert review over the internet. • Stage 3 review (final assessment stage) to integrate the results of Stage 2 reviews. Face-to-face review conducted by a multidisciplinary committee.
Review Criteria	Three equally weighted criteria: • Scientific or engineering excellence of the researcher • Merit of the proposal • Contributions to the training of highly-qualified personnel	Three criteria: • Challenge: the aim and importance of the endeavour (40%) • Feasibility: the plan to achieve excellence (20%) • Capability: the expertise to succeed (40%)	Two criteria for Stage 1: • Calibre of applicant (75%) • Vision and program direction (25%) Two criteria for Stage 2: • Quality of the program (50%) • Quality of the expertise, experience, and resources (50%)

Note: The information contained here does not align perfectly with that in Exhibit 4.5 as they cover different time periods.

Source: Compilations from the secretariat based on information provided by the granting councils.

A1.2

Exhibit A1.2: Other Funding Agreements

Organization	Role	Federal Funding
Brain Canada	Registered charitable organization that funds multidisciplinary, collaborative, high-risk, high-reward brain research through an open, international peer review process. Founded as NeuroScience Canada in 1998.	2012: Commitment of $100 million over six years, to be matched by other donors. Budget 2016: Up to $20 million over three years, starting in 2016-17, for the Brain Research Fund. To be matched by other non-government partners. **Total: $120 million**
CANARIE	Non-profit corporation founded in 1993 that delivers digital research infrastructure in Canada.	1993–2015: $529.5 million total. Budget 2015: An additional $105 million over five years. **Total: $634.5 million**
Centre for Drug Research and Development (CDRD)	Not-for-profit corporation founded in 2007 that focuses on translating and commercializing early-stage health research from academic institutions and Canadian SMEs into marketable products.	2008–2016: $37.03 million total. Budget 2016: Up to $32 million over two years, starting in 2017-18. **Total: $69.03 million**
Canadian Institute for Advanced Research (CIFAR)	Not-for-profit organization founded in 1982 that funds Canadian and international researchers to study complex scientific, social and economic issues.	1987–2015: $109 million in federal funding. Budget 2015: $5 million over two years expiring March 2017. **Total: $119 million**
Institute for Quantum Computing (IQC)	Conducts experimental and theoretical research on quantum computing and performs scientific outreach. IQC was founded in 2002.	2009–2014: $68 million total. Budget 2014: Announced a further $15 million over three years expiring March 2017. **Total: $83 million**
Mitacs	Not-for-profit organization founded in 1999 that supports student research internships and postdoctoral fellowships in industry, and links foreign and Canadian students with research expertise, training, and networking opportunities.	1999–2016: $115.8 million total. 2016-17 to 2020-21: $166.3 million. **Total: $282.1 million**
National Optics Institute (INO)	Not-for-profit organization founded in 1985 that supports research and provides development assistance to firms in the field of optics and photonics.	2006–2015: Federal support averaged $9 million per year. Budget 2016: $50 million over five years, starting in 2016-17.
Perimeter Institute	Founded in 1999, independent non-profit theoretical physics research institute. Supports a large educational outreach program. Substantial international reputation.	2007–2016: $140 million total. Budget 2016: Starting in 2017-18, federal funding of $50 million over five years. Each dollar is to be matched with two dollars from the institute's other partners. **Total: $190 million**
Stem Cell Network	Funds stem cell and regenerative medicine research with a focus on translating research into commercial products. The Stem Cell Network was founded in 2001.	2001–2017: $83.3 million. Budget 2016: Up to $12 million over two years starting in 2016-17. **Total: $95.3 million**

A2.1

Exhibit A2.1: Summary of Online Submissions

Source	Submissions
Online (Open Submission Form) June 12 – August 12	374
Online (Community Responses) August 12 – September 30	753
By Email	148
Total	1,275

A2.2

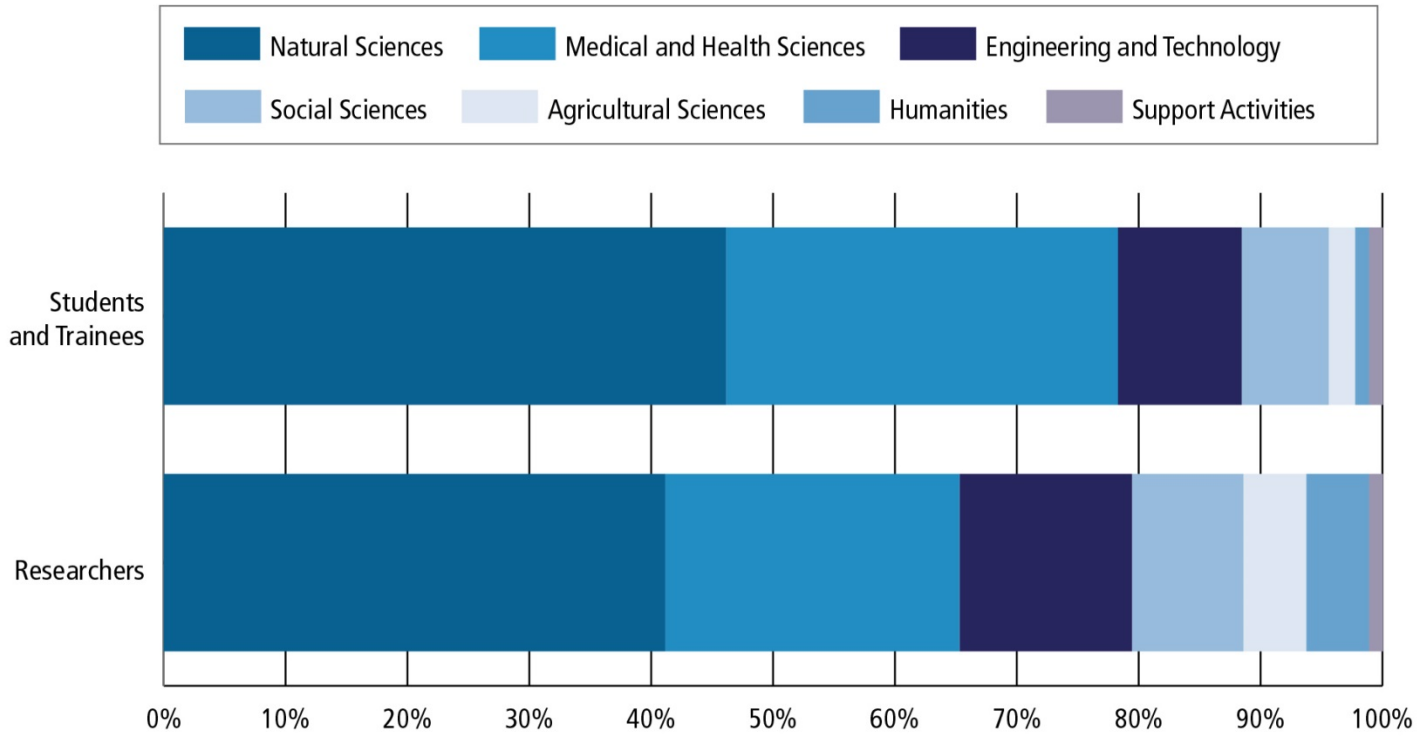
Exhibit A2.2: Summary of Online Community Responses

Community	Submissions	# of Questions in Survey	Average Proportion of Questions Answered
Researchers	523	22	63%
Students and Trainees	111	17	61%
Administrators	22	18	63%
Institutions	60	18	38%
Others	37	N/A	N/A

A2.3 - A

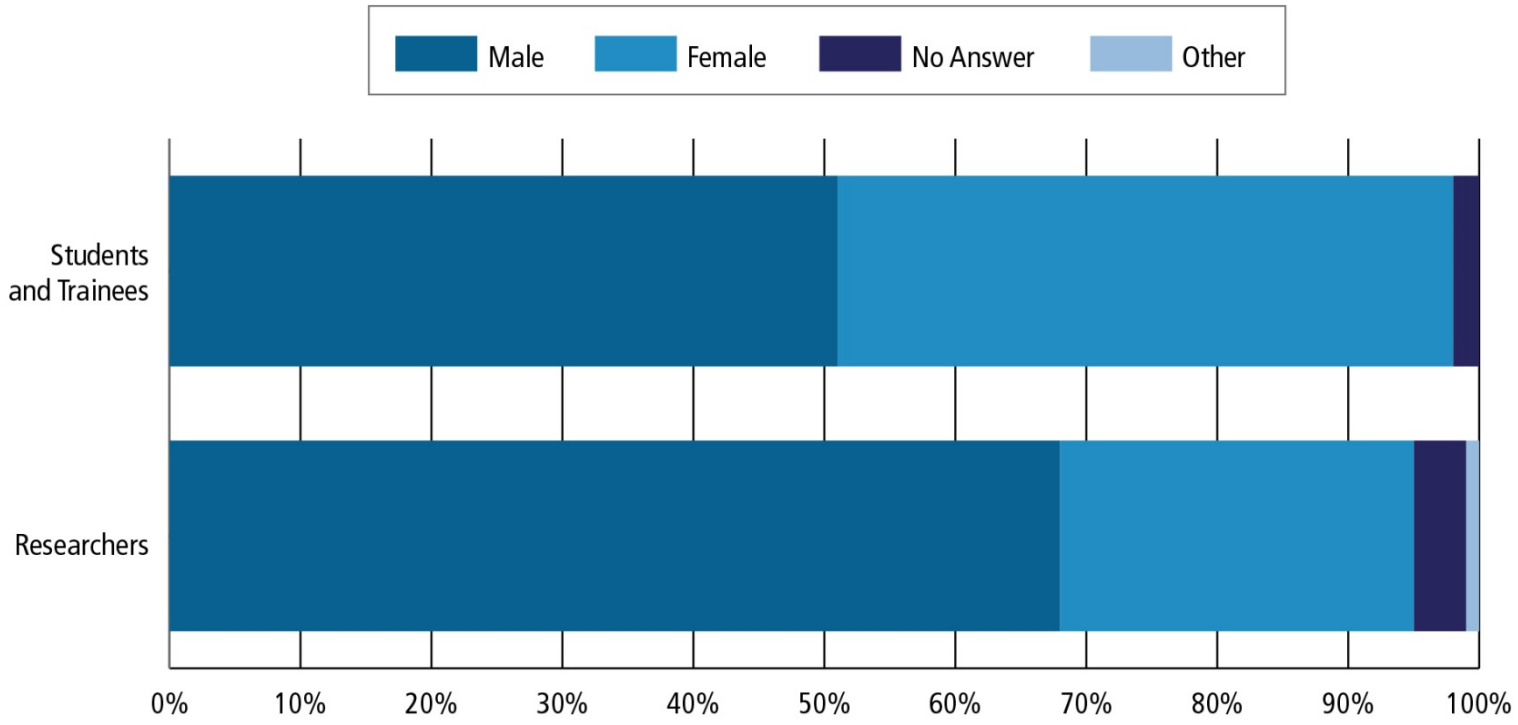
Exhibit A2.3: Profile of Respondents from the Community

A. Community responses: by discipline



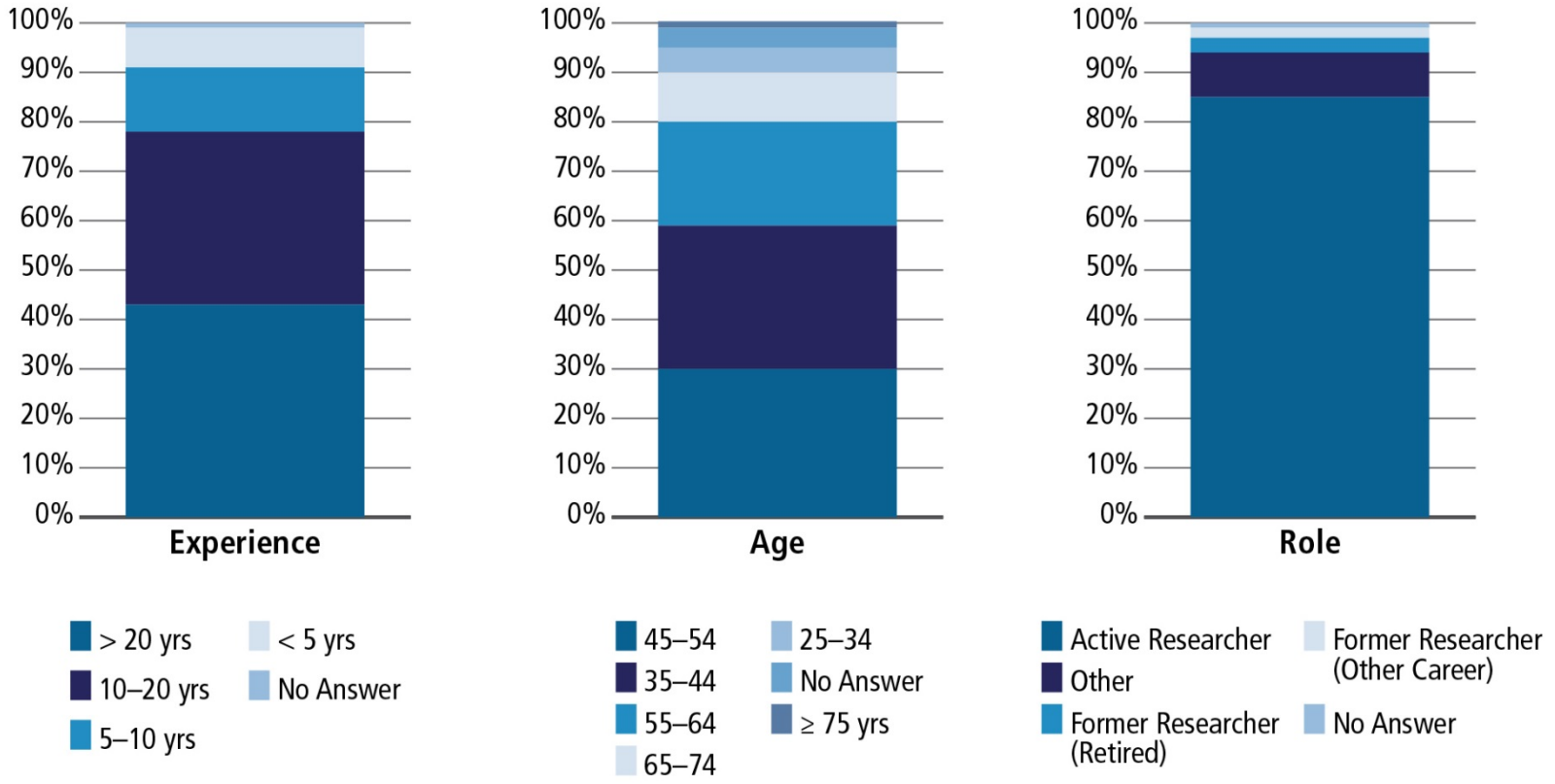
A2.3 - B

B. Community responses: by gender



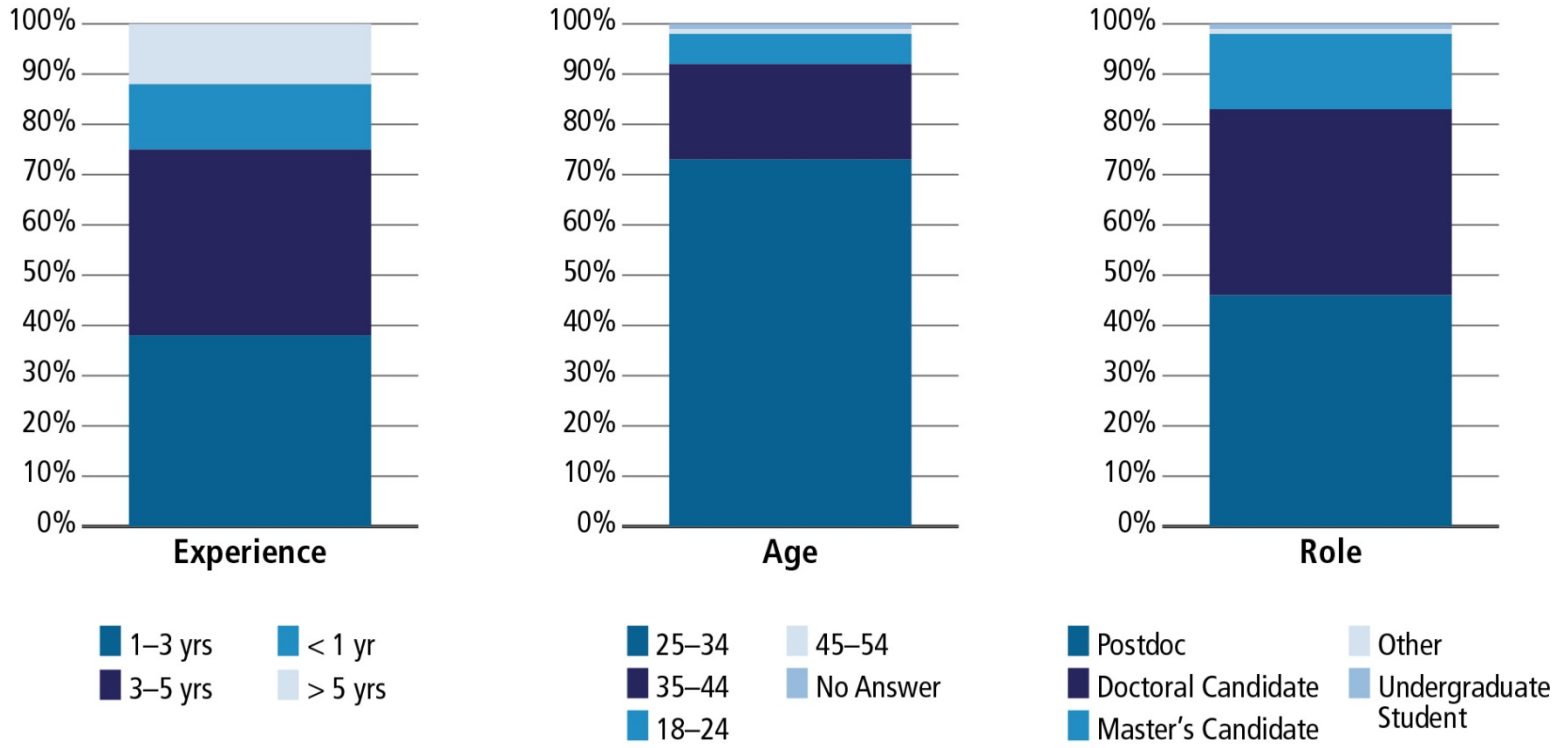
A2.3 - C

C. Community responses: researchers



A2.3 - D

D. Community responses: students and trainees



A2.4

Exhibit A2.4: Number of Responses by Community

Community Represented	Reponses
Administrators	4
Facilities	22
Funders	15
Institutions	52
Provinces and Territories	4
Researchers	35
Students and Trainees	4
Other	12

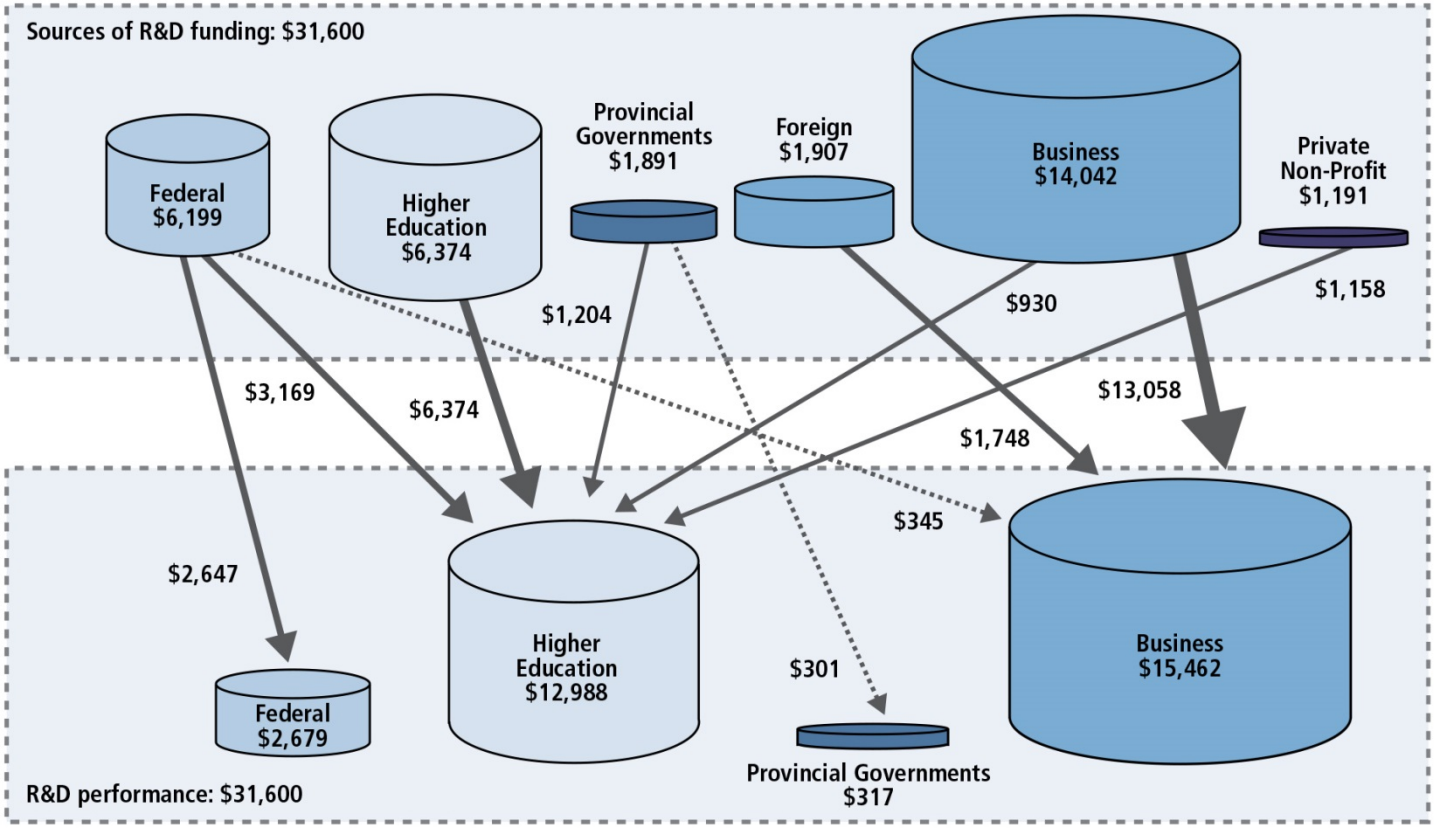
A2.5

Exhibit A2.5: Roundtables

Date	Location	Roundtable Topic	No. of Attendees	Description
July 26	Toronto	Early Career Researchers and Trainees	13	Unique barriers faced by researchers early in their careers
Sept. 15	Ottawa	Researchers in Canada	21	General discussion about the funding of investigator-led research in Canada
Sept. 29	Calgary	Researchers in Canada	13	General discussion about the funding of investigator-led research in Canada
		Big Science – Infrastructure	20	Domestic funding of large science research facilities in Canada; Canadian participation in large international projects
		Big Science – Wicked Problems and Platform Technologies	13	Government funding in areas of broad strategic interest, societal application, or emerging technologies
Oct. 11	Montreal	Researchers in Canada	24	General discussion about the funding of investigator-led research in Canada
		International Research	26	The growing trend of international collaboration; flexibility of funding international collaboration (included large infrastructure) and Canada's voice on the international stage
		Social Sciences and Humanities	23	Unique barriers faced by the social sciences and humanities communities in terms of investigator-led research including collaborating with other disciplines
Oct. 17	Halifax	Researchers in Canada	16	General discussion about the funding of investigator-led research in Canada
		Multidisciplinary Research	17	The growing trend of multidisciplinary research. Is the Canadian funding system able to support research across disciplines (i.e., granting councils)?
		Diversity	22	Unique barriers faced by women, indigenous, and other underrepresented groups in obtaining support for investigator-led research
Oct. 24	Toronto	Eminent Researchers	15	General discussion on investigator-led research in Canada with a select group of distinguished participants

A3.1

Exhibit A3.1: GERD Matrix – Major Flows of Funding, Canada ($ Millions)



Note: Data are for 2015. Only flows higher than $300 million are shown.

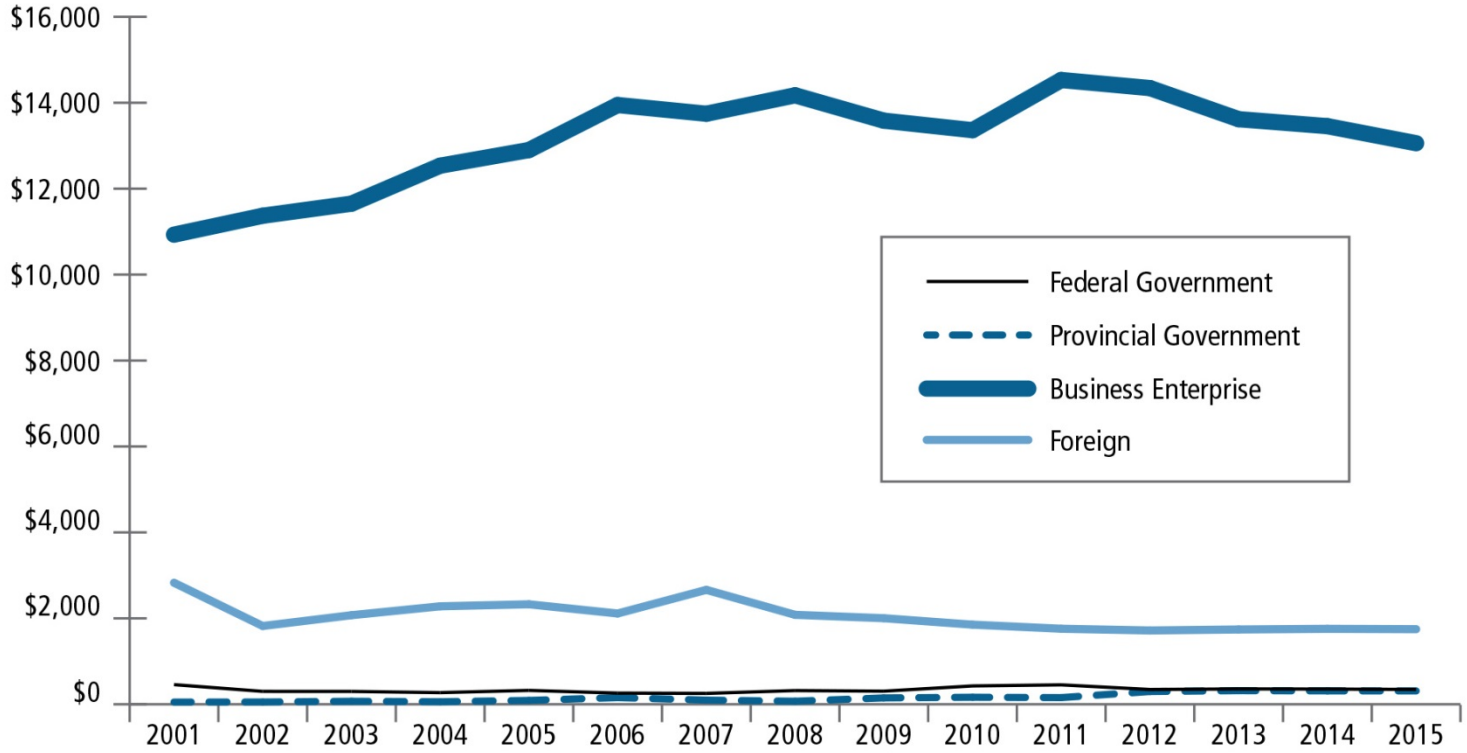
Source: Statistics Canada, CANSIM table 358-0001. Funding figures refer to intentions and not final expenditures.

A3.1

Sector	Domestic Performers of R&D ($ Millions)		Sources of GERD Funding ($ Millions)	
	2011	2015	2011	2015
Federal Government	$2,649	$2,679	$6,220	$6,199
Provincial Government	$300	$285	$1,788	$1,885
Provincial Research Organizations	$32	$32	$4	$6
Business Enterprise	$16,894	$15,462	$15,586	$14,042
Private Non-Profit	$127	$158	$1,153	$1,191
Higher Education	$11,832	$12,988	$5,193	$6,374
Foreign	N/A	N/A	$1,891	$1,907

A3.2

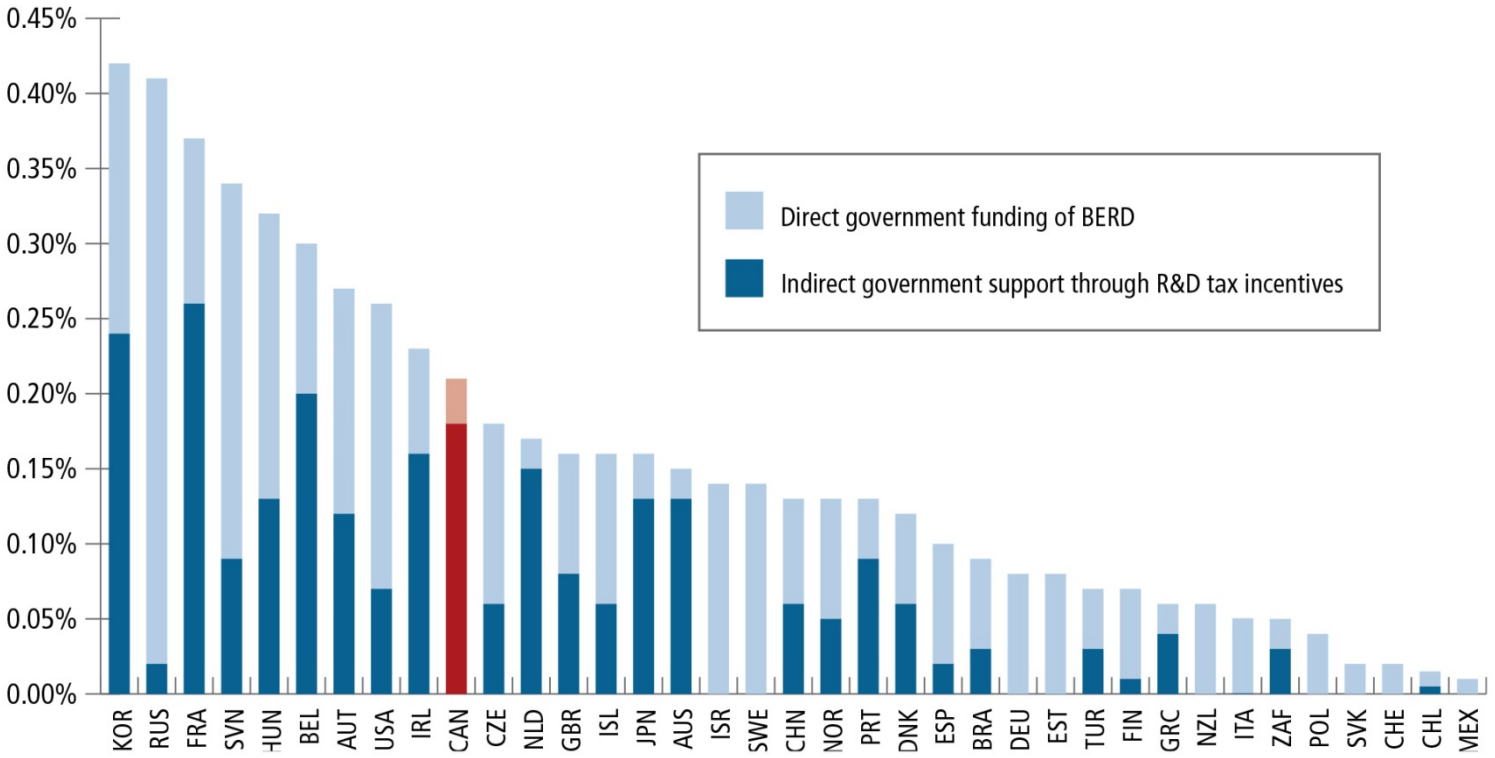
Exhibit A3.2: Sources of R&D Funding to the Business Enterprise Sector, by Funding Sector, 2001 to 2015 ($ Millions)



Source: Statistics Canada, CANSIM table 358-0162.

A3.3

Exhibit A3.3: Direct Government Funding of Business R&D and Tax Incentives for R&D, 2013 (as a Percentage of GDP)



Note: Data on indirect government support through R&D tax incentives are not available for Israel and Poland.

Source: OECD Science, Technology and Industry Scoreboard 2015, OECD Publishing, Paris.
Available from: http://dx.doi.org/10.1787/sti_scoreboard-2015-graph156-en

A3.4

Exhibit A3.4:
Triadic Patent Data, 2013

Country	Triadic Patent Families
Canada	0.42
United States	1.12
Australia	0.34
United Kingdom	0.68
Germany	1.71
France	0.96
Italy	0.28
Japan	3.17
Republic of Korea	1.54
China	0.03
Netherlands	1.41
Belgium	1.05
Sweden	1.61
Switzerland	3.77
Austria	1.47
Israel	1.27
Taiwan	0.49
Singapore	0.64

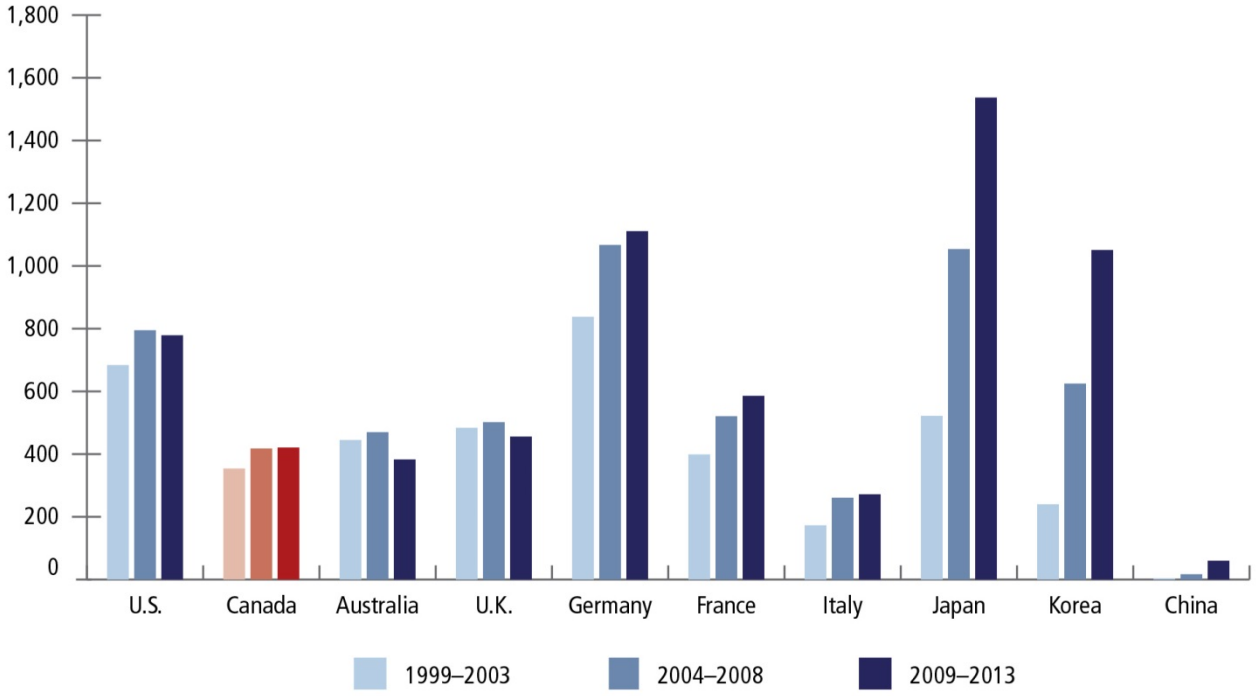
Note: Data are normalized for population, and relative to the OECD averages, which are set to 1.0.

Source: OECD, Main Science and Technology Indicators, 2013. Available from: http://www.oecd.org/science/inno/msti.htm
Supplemented with data from the Taiwan Statistical Data Book, National Development Council. Available from: http://www.ndc.gov.tw/en/News.aspx?n=607ED34345641980&sms=B8A915763E3684AC

A3.5 - A

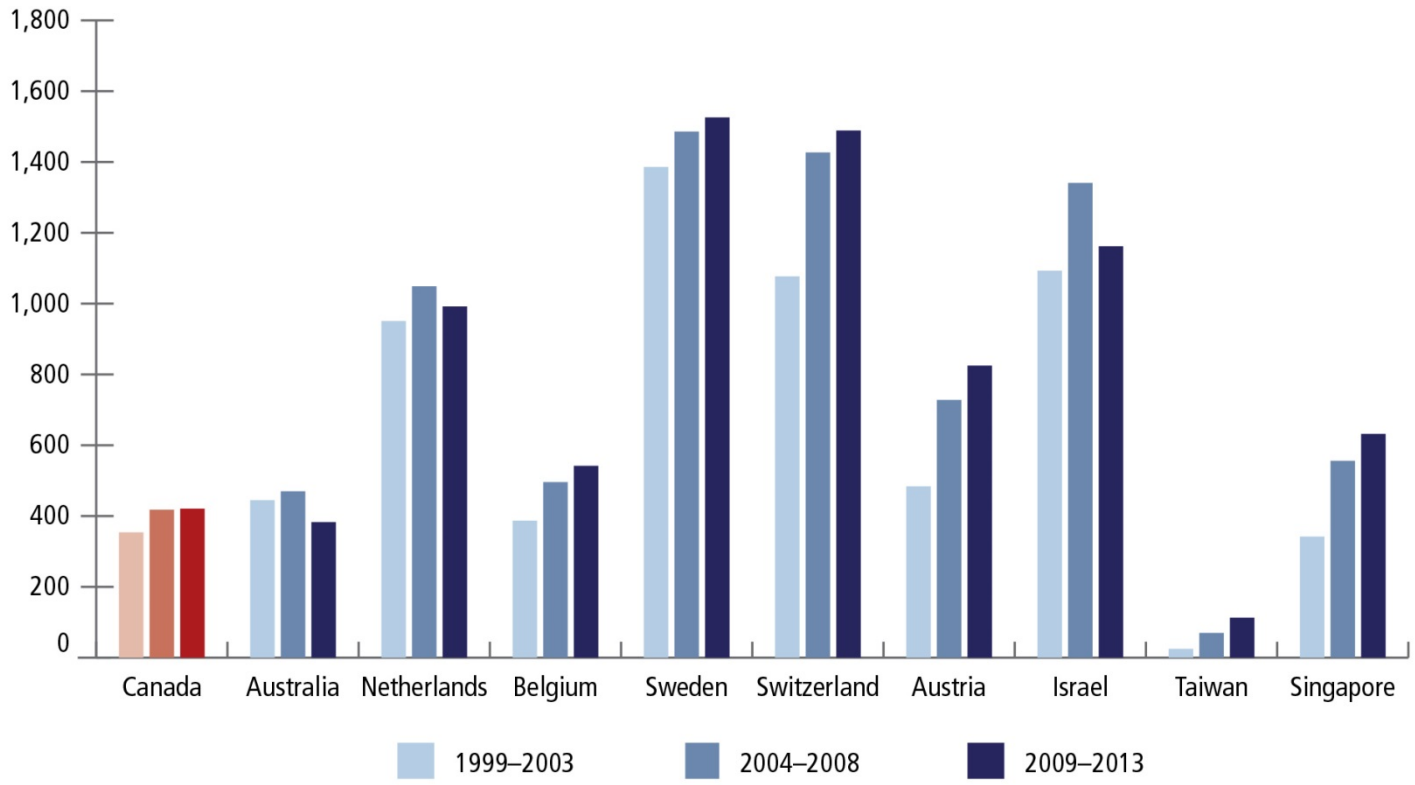
Exhibit A3.5: Patent Cooperation Treaty (PCT) Patent Applications per Million People, by Country of Inventor

A. Canada as compared to select G7 countries, Australia, and key east Asian countries



A3.5 - B

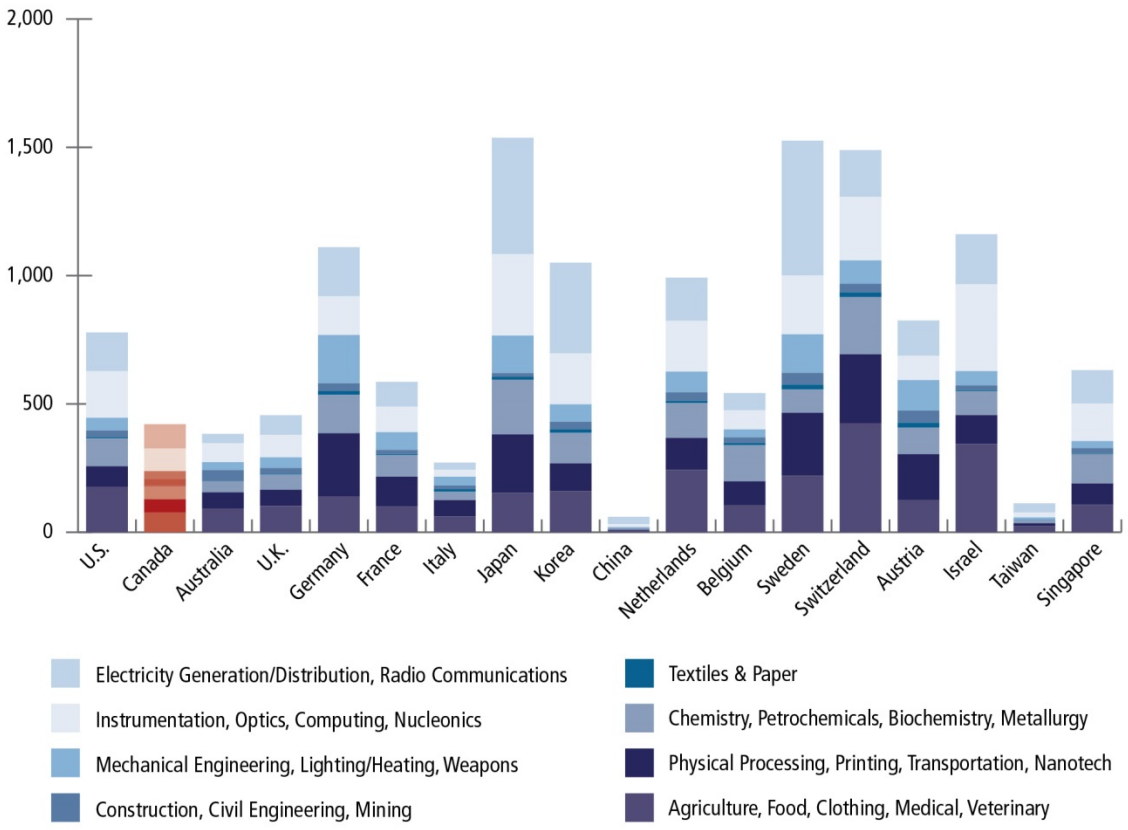
B. Canada as compared to smaller peer countries



Source: OECD, Science Technology and Patents, Patent Statistics. Available from: http://stats.oecd.org. Population data from United Nations Department of Economic and Social Affairs. Available from: https://esa.un.org/unpd/wpp/Download/Standard/Population/ Supplemented with the Taiwan Statistical Data Book, National Development Council. Available from: http://www.ndc.gov.tw/en/News.aspx?n=607ED34345641980&sms=B8A915763E3684AC

A3.6

Exhibit A3.6: PCT Patent Applications per Million People, by Technology Area, 2009 to 2013



Source: OECD, Science Technology and Patents, Patent Statistics. Available from: http://stats.oecd.org. Population data from United Nations Department of Economic and Social Affairs. Available from: https://esa.un.org/unpd/wpp/Download/Standard/Population/. Supplemented with the Taiwan Statistical Data Book, National Development Council. Available from: http://www.ndc.gov.tw/en/News.aspx?n=607ED34345641980&sms=B8A915763E3684AC. For details of the IPC classification see http://www.wipo.int/ipcpub/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