



INVESTING IN CANADA'S FUTURE

Strengthening the Foundations of Canadian Research

“Our government must ensure its support for fundamental research is coherent, effective and agile enough to keep pace with the dynamic nature of contemporary science.” — The Honourable Kirsty Duncan, Minister of Science

Panelists

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CANADA'S FUNDAMENTAL
SCIENCE REVIEW



MANDATE AND CONSULTATIONS

Two main mandate questions:

- Are there any overall program gaps in Canada's fundamental research funding ecosystem that need to be addressed?
- Are there elements or programming features in other countries that could provide a useful example for the Government of Canada in addressing these gaps?

Consultation

- 1,275 submissions from individuals, associations, and other organizations.
- Roundtables in five Canadian cities engaging 230 researchers.

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



A CASE FOR SCIENCE AND INQUIRY

A vibrant research ecosystem is essential to:

- Living longer and healthier lives in a cleaner and safer environment.
- Protecting and enriching Canada's diverse cultures and heritage.
- Developing innovative technologies, goods, and services that contribute to our economic prosperity and create fulfilling jobs.
- Sustaining our economic sovereignty, standard of living, and valued social programs.
- Fostering a creative, vibrant, and inclusive society.
- Stimulating informed public debate.
- Supporting evidence-based policy-making in a period of accelerating change and complex domestic and global challenges; and
- Educating and inspiring the next generation of innovators in all walks of life.

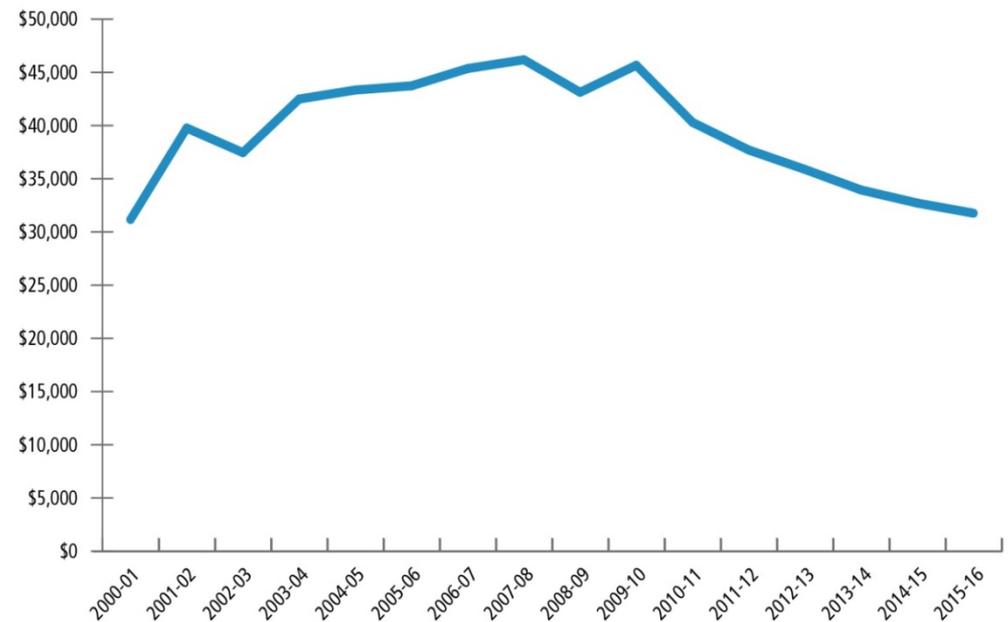
RESOURCES

“As a small country, Canada may not be able to invest in basic research at the same levels as the world’s top economies in absolute terms. However, in relative terms, we must be at or very near the top of the funding pyramid”

Key facts:

- Dropped out of top 30 nations for “research intensity”.
- GERD intensity declining.
- HERD touted as highest in the G7, but only 23% from federal sources in 2015.
- Granting council funding per researcher in steady decline since 2008-09, in constant dollars.

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.



PERFORMANCE

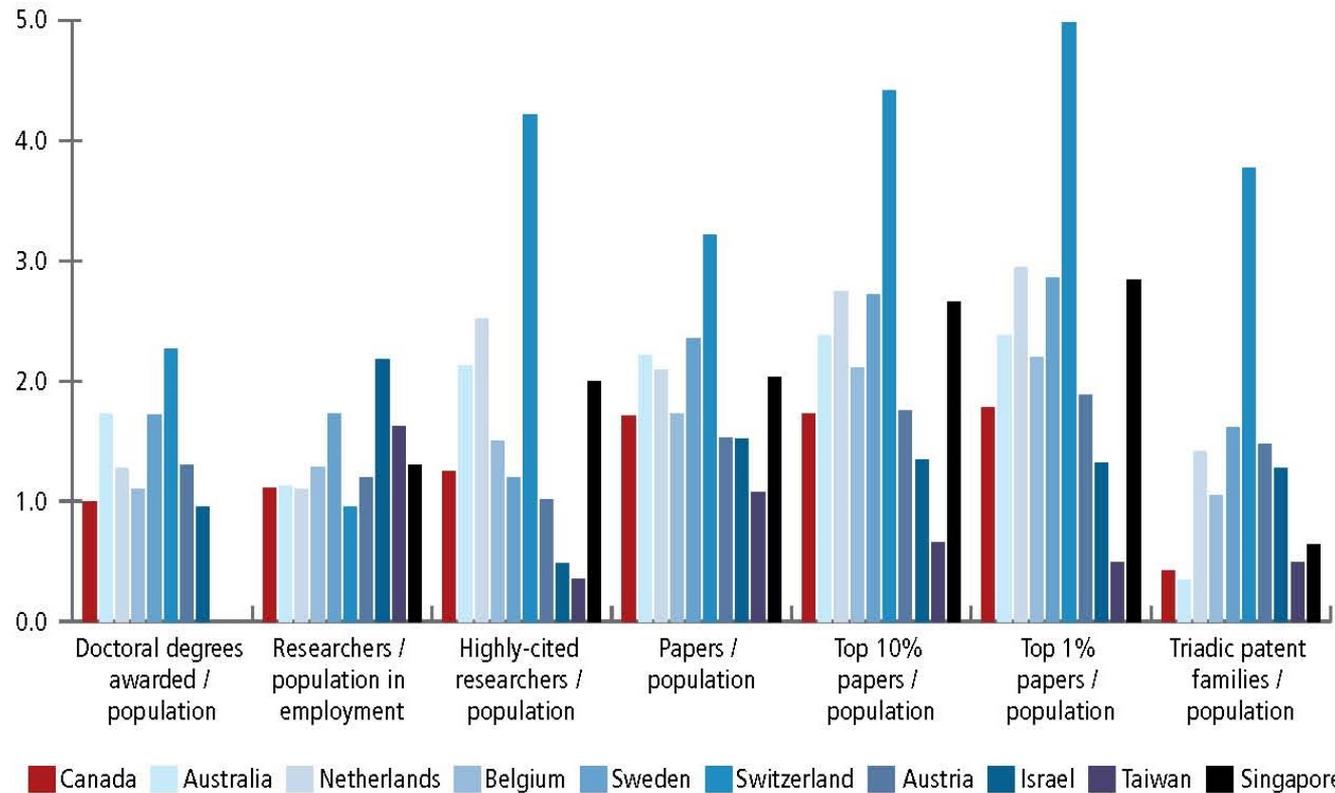
“The bar we set for our investment in research should be the quality of its output.”

Key findings:

- Canada remains above-average in citations, helped by below-average impact of massive volume of publications from China.
- Declining outputs highlighted in report could be arguably offset if Canadian research showed rising impact as measured by citation analysis.
- Canada is strong performer in certain fields, but citation ranking fell in 13 of 22 fields assessed.
- Canada lags many other nations in winning international prizes, not least Australia.

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.

FINDINGS

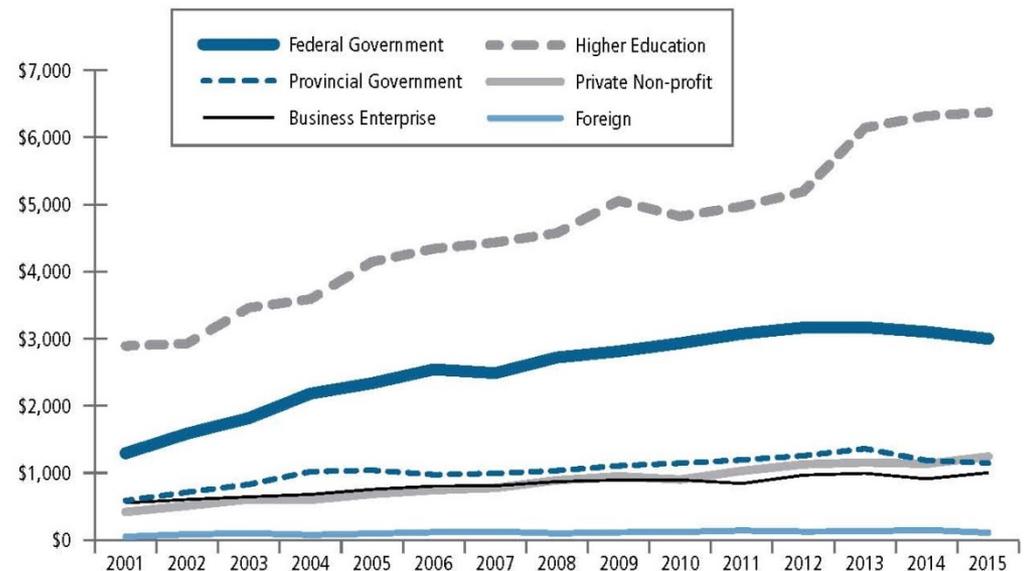
Canadian accomplishments have long been a source of national pride, but:

- research competitiveness has been eroded,
- a need to strengthen stewardship of federal research ecosystem, and
- flat-lining of federal spending paired with a decline in proportion of federally derived funding for research.

Recommendations form a comprehensive agenda to strengthen the foundations of Canadian extramural research.

- **Chapters 4&5 – Oversight/Governance**
- **Chapters 6&7 – Programs/Funding**

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.



GOVERNANCE – WHY THE FOCUS?

Clear evidence of weak system-level oversight:

- Suboptimal coordination across the pillar agencies.
- Puzzling inconsistencies in program architecture.
- Uneven decision making on investments in national science facilities.
- Discrepant success rates and blurred accountabilities
- Proliferation of disconnected entities arising from opportunistic decisions, some inspired and some not
- Importance of coordination of university and federal government science

Urgency:

- Urgent given weakening competitive position, critical societal and economic challenges, and major opportunities created by global political trends.
- Strategic advice on both research and innovation is necessary in short term as innovation ecosystem to undergo review and possible overhaul.



STEWARDSHIP AND GOVERNANCE

“Canada’s federal research ecosystem, despite many strengths, is weakly coordinated and inconsistently evaluated, and has not had consistent oversight.”

Related recommendations:

- National Advisory Council on Research and Innovation (NACRI).
 - Advice, coordination and strategic alignment, evaluation.
- Chief Science Advisor – Vice Chair of NACRI, integrated Secretariat.
- Four Agency Coordinating Board.

Rationale:

- Canada, for a long time, has needed high-level overview and coordination of research efforts - concerns date back to the 1910s.
- Current advisory systems have not had the stability and support to make a lasting contribution.
- Further machinery changes may be needed if major improvements do not occur rapidly.



EXAMPLE – COORDINATION OF AGENCY INITIATIVES

Related recommendations:

- Four Agency Coordinating Board

Rationale:

- Encouraging but piecemeal efforts to improve, highly dependent on preferences of agency presidents.
- Need to prioritize cross-cutting issues related to: early career researchers, equity and diversity, indigenous scholars and research, peer review.

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.



RECOMMENDED RESOURCES TO SUPPORT ECOSYSTEM

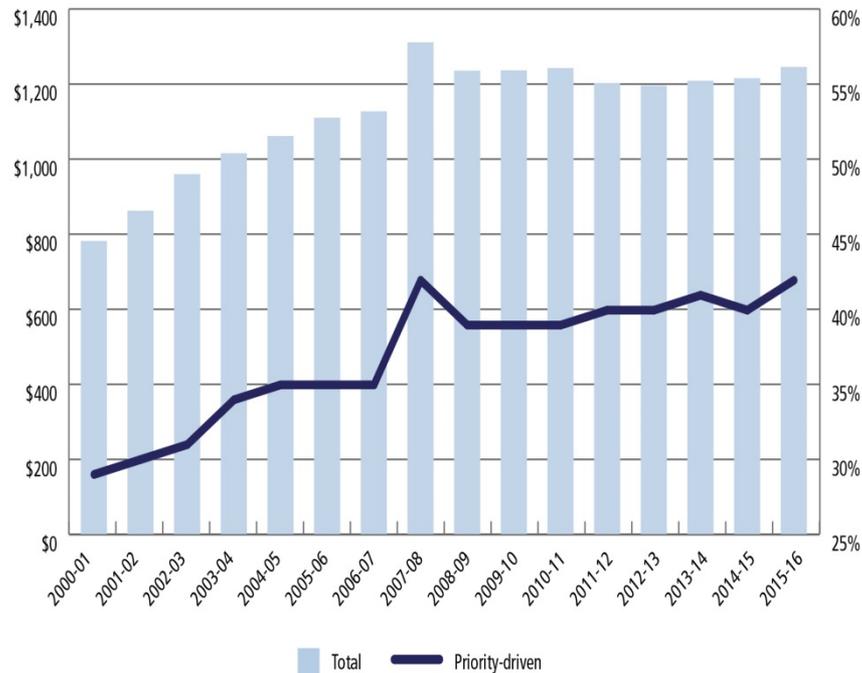
“Independent science and scholarly inquiry have been underfunded for much of the past decade, as the federal government has concentrated resources on innovation-facing and priority driven programs”

Key challenges and considerations:

- Small and declining share of HERD attributable to the federal government.
- Anomalous dependence on institutional subsidies.
- Declining research performance on multiple measures.
- Trends in per researcher funding.
- Demographics of the research community.
- Density of full-time researchers and senior research trainees.
- Success rates.

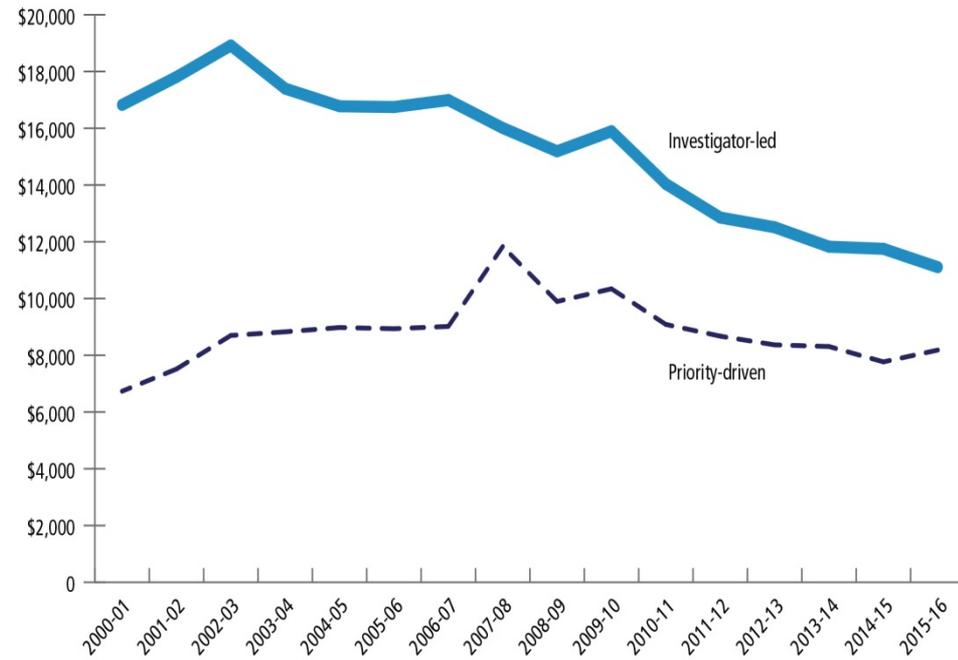
DIRECT PROJECT FUNDING - PRESSURES

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.

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.



DIRECT PROJECT FUNDING

“The panel’s single-most important recommendation is that the federal government should rapidly increase its investment in independent investigator-led research”

Related recommendations:

- \$485 million, over 4 years to increase investment in independent investigator-led research.
- Systematic approaches for international collaboration, multidisciplinary work, high-risk ventures, and projects requiring a rapid response.

Rationale:

- Moves balance of funding back toward a 70:30 ratio.
- Addresses current gaps.

	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

INFRASTRUCTURE

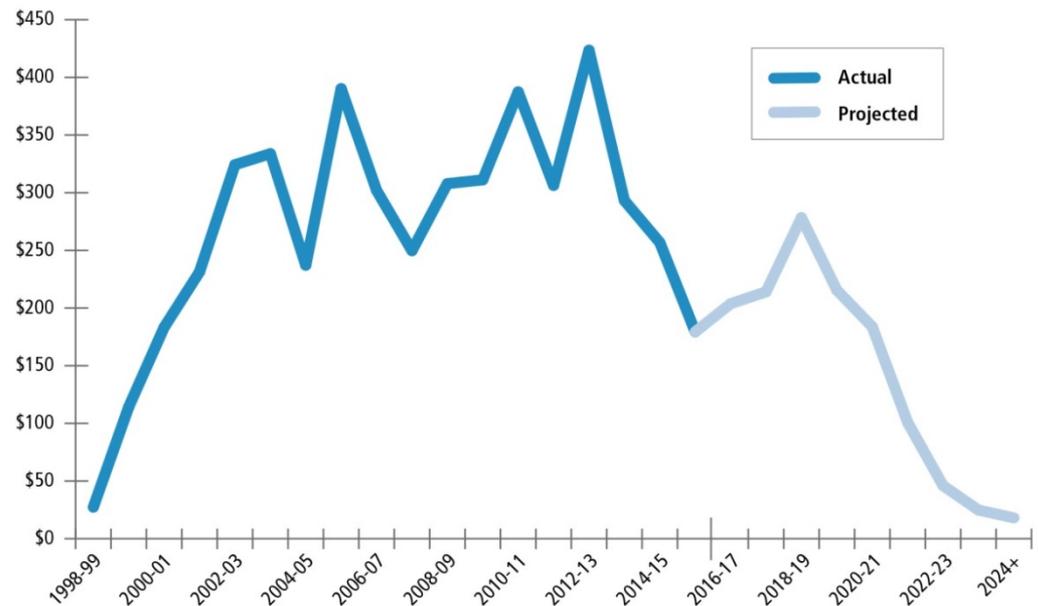
Related recommendations:

- Stabilize CFI funding.
- Digital research infrastructure.
- MSIs/Infrastructure operating costs.

Rationale:

- Saw-tooth pattern impedes planning and coordination.
- More coordination needed for digital research infrastructure.
- MSI matching fund requirement is challenging.
- Operating cost difficulties for smaller capital awards.

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



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

	Year 1	Year 2	Year 3	Year 4
Operating Funds for Major Research Facilities	35	35	35	35
Operating Funds for Small Capital Projects	30	30	30	30



PERSONNEL

Related recommendations:

- Harmonize scholarship and fellowship programs and optimize to attract international talent.
- Improve funding levels, allocation, and management of CRC awards.

Rationale:

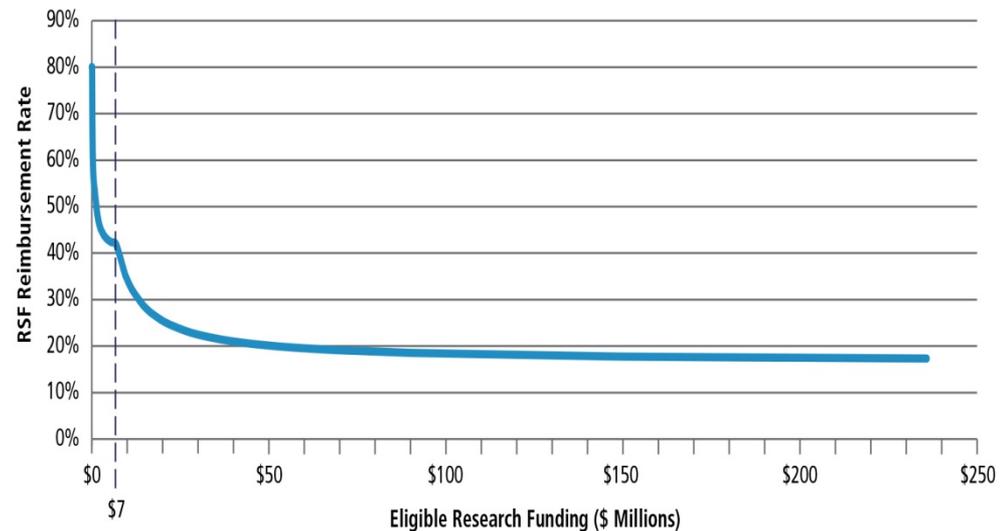
- Strategic federal investments can advance the overall research enterprise by developing and/or attracting, and then supporting, the outstanding personnel needed to achieve excellence.
- Real award values for CRC have diminished over time, students/trainees are underfunded.
- The current mix of graduate and post-graduate awards vary considerably by value, duration, and international portability.

	Year 1	Year 2	Year 3	Year 4
Scholarships and Fellowships	35	70	105	140
Research Chairs for Excellent Scholars and Scientists	35	140	140	140

FACILITIES AND OPERATIONS

“The much larger issue is strengthening the overall institutional fabric of Canadian research.”

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.

	Year 1	Year 2	Year 3	Year 4
Facilities and Administration Costs (Research Support Fund)	96	206	362	478

Related recommendations:

- Improve RSF reimbursement rate.

Rationale:

- Current average reimbursement level at 21.6 per cent of eligible grants – very low comparatively.
- F&A costs are significant: maintaining equipment, regulatory standards, computational services, managing IP, lighting, and heating, administering grants and awards.
- Universities cross-subsidize research mission at expense of teaching.

SUMMARY – RECOMMENDED RESOURCES

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

CONCLUSION

“Given global competition, the role of research in underpinning innovation and educating innovators, the need for evidence to inform policy-making, and the current unsettled conditions in the research ecosystem, the Panel firmly believes that this commitment is also among the very highest-yield investments in Canada’s future that any government could make.”

Urgent action needed:

- Stronger oversight and governance.
- Transformative investments.

