Following discussion with its twenty four professional and scientific member organizations, representing more than 60,000 scientists, the Partnership Group for Science and Engineering of the Royal Society of Canada (PAGSE) presents this submission to Canada's Fundamental Science Review. The prosperity of a society is supported by a *strong and successful middle class*, but a nation's Science Technology and Innovation (STI) ecosystem is supported by ***a productive and diverse community of basic researchers***. This brief summarizes the key messages received from our community on how to nurture science and engineering research in Canada, specifically by 1) Strengthening and rebalancing the federal science funding ecosystem; and 2) Supporting innovation through inclusivity, diversity, and interdisciplinarity.

BACKGROUND

PAGSE's mandate is to speak on behalf of the Canadian science and engineering community to the Government of Canada and to advance research and innovation for the benefit of all Canadians. Our monthly Bacon and Eggheads Breakfast lecture series, brings together expert scientists, engineers and parliamentarians to showcase outstanding Canadian research and to provide insight on timely scientific issues. Many of the organizations we represent have submitted their own briefs that outline unique opportunities and challenges for their specific disciplines. In this submission we wish to highlight overarching themes that have emerged from our nationwide community.

ITEM 1. Continue to strengthen and rebalance the federal funding ecosystem

A) The Government of Canada should increase support for basic research

The innovation capacity of a nation and its ensuing prosperity depends on a solid foundation of ***well-supported basic research.*** The OECD considers basic research to be focused on knowledge creation with no specific application in view. Basic research serves as the source from which new ideas can emerge and allows for the training of the next generation of innovators. Fundamental, curiosity-driven research will lead to advances that improve our health, create businesses and jobs, and present Canada as a leader in the knowledge economy. Consider, as an example, the Nobel-prize-winning research of Dr. Michael Smith's research on site-directed mutagenesis, carried out at the University of British Columbia. His insight, introducing mutations into DNA, has led to many applications, most notably our ability to alter the DNA in a strain of yeast and produce human insulin. Time and again, basic science in Canada leads to unexpected and transformative impacts.

The Scientific Advisory Board of the Secretary General of the United Nations suggests that in order to effectively advance science, technology, and innovation, national research and development funding should reach 3.5 per cent of GDP.[1] From 2005 to 2014, research funding in Canada fell from 2.0 per cent to 1.6 per cent of GDP.[2] The recent infusion into the Tricouncil was vital, but greater investment is needed in order to move Canada away from its low ranking in gross domestic expenditures on research and development. Canada should aim to bring its research funding level to 3.5 percent of

[1] https://www.eurekalert.org/pub_releases/2015-07/tca-i3g070715.php

[2] Gross Domestic Expenditures on Research and Development in Canada (GERD), the Provinces and Territories, Statistics Canada, http://www.statcan.gc.ca/pub/88-221-x/88-221-x2015001-eng.htm

GDP by 2025. A majority of this investment should be targeted to ***"unfettered" researcher-driven operating grants*** and continued investment in infrastructure. Our members have noted that there is great value in strategic funding to build up uniquely Canadian strengths and priorities (e.g., research in the North such as supported by the Polar Continental Shelf Project), but that care must be taken to ensure that these initiatives do not outstrip our support for basic research.

We recommend continued increases in the budgets of both CIHR and NSERC to be targeted to investigator-led research funded through the Discovery Program at NSERC and Project/Foundation Programs at CIHR. The average NSERC Discovery Grant in 2015 was $32,132, making it difficult for many of researchers to compete at an international level. Similarly, low success rates for CIHR researchers, particularly those involved in basic research, coupled with the high cost of biomedical/health research have led to a funding crisis at CIHR. Given the acute needs of our health researcher community, an infusion of funding into CIHR is desperately needed, but not in the context of a zero-sum funding environment, in which research funds in one area are diminished so that they can be redirected to another.

B) Research infrastructure support needs to be increased and extended

In the modern research environment, research productivity and innovation are intimately linked to the availability of appropriate infrastructure. The $2 billion research infrastructure infusion in Budget 2016 was an excellent signal that the need for

infrastructure is clearly understood by our government and further investments are needed. ***PAGSE members have suggested a unified approach to the funding of research infrastructure over its entire lifecycle*** (installation, maintenance, upgrades, personnel support) that accommodates both small-scale basic equipment and large scale cutting-edge facilities and is unhampered by high matching fund requirements. This could be accomplished through increased funding of the CFI for large Innovation grants and the John R. Evans Leaders Fund for individual researchers. Increases to the NSERC Research Tools and Instruments Grants Program and the reinstatement of a modest equipment funding program at CIHR, or the inclusion of these types of programs under CFI's umbrella, are also recommended. There is an urgent need to renew aging infrastructure that is currently not eligible for the CFI. Furthermore, research infrastructure alone cannot drive discovery. The "infrastructure operating funds" that accompany CFI support and link the funding for personnel to the infrastructure are vital and must be strengthened.

ITEM 2. Support Diversity of Research and Researcher.

A) Diversity should be monitored and supported

Diversity, both in research topics and the research community, helps drive innovation. Our foundation of basic researchers needs to reflect our best scientific talent, with representation from all groups in society including women and minorities. PAGSE members support the implementation of diversity standards on all federal review panels,

and unconscious bias training for panel members. Salary awards such as Canada Excellence Research Chair (CERC) and Canada Research Chair (CRC) awards in particular should be evaluated for bias in their nomination and review process. Only 1 of the 27 CERCs and 17% of CRC Tier I holders are women. More broadly, federally funded researchers could be required to devote 1% of their budget to mandatory outreach that targets an underrepresented group in that particular research area.

B) Interdisciplinary research needs increased support

Canada's support for basic research should not be limited to areas that fit neatly into pre-existing silos. Often exciting discoveries emerge at the interface of scientific fields, yet there remain significant barriers to collaboration across the Tricouncils. The oversubscription of the Collaborative Health Research Projects (CHRP) program (joint NSERC/CIHR) is a testament to the need for ***interdisciplinary funding opportunities***. In response to this need, we have heard from members who support the creation of a Governing Research Council which could increase coordination and collaboration between programs, ensure there is no duplication of efforts, and build the funding capacity for interdisciplinary research.

We thank the Advisory panel for the opportunity to present our views and to participate in the national consultation. Please do not hesitate to contact us at pagse@rsc-src.ca if you have any questions about our submission.

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