

**Association of Universities
and Colleges of Canada**



**Association des universités
et collèges du Canada**

**AUCC Submission to the Minister of Industry and the
Minister of Finance on the Development of a
Science & Technology Strategy for Canada**

February 8, 2007

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and Colleges of Canada**



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Established in 1911, the Association of Universities and Colleges of Canada represents 91 Canadian public and private not-for-profit universities and university-degree level colleges. Our mandate is to foster and promote the interest of higher education, both within Canada and abroad.

Table of contents

SUMMARY AND RECOMMENDATIONS.....	i
INTRODUCTION	1
TAKING IT TO ANOTHER LEVEL	3
Identifying areas of strength where Canada can be a world leader	3
Ensuring the conditions for research excellence.....	5
Enhancing linkages between the universities and the private sector	8
DEVELOPING NEW RESEARCH TALENT.....	11
Developing a research and science culture	11
Providing undergraduate research experiences.....	12
Providing more opportunities for talented students to pursue graduate studies	13
Providing opportunities for young researchers	15
GETTING IT RIGHT	18
Increasing collaboration among federal funding agencies.....	18
Measuring success in relation to federal investments in university research	22
Transferring management of federal laboratories to universities	25

AUCC Submission to the Minister of Industry and the Minister of Finance on the Development of a Science & Technology Strategy for Canada

SUMMARY AND RECOMMENDATIONS

The federal government's economic plan, *Advantage Canada*, commits to maintaining Canada's G7 leadership in public sector R&D investment, a very significant portion of which is university-based research. This will require increased investments in ideas and talent, as well as efforts to maximize the impact of government investments and ensure that the system of federal support is as effective, efficient and accountable as possible.

AUCC welcomed the announcement in the May 2006 budget that the Minister of Industry, in collaboration with the Minister of Finance, will develop an S&T strategy for Canada. AUCC has prepared this submission as a contribution to the process of developing this S&T strategy. The submission focuses on developing recommendations in three areas.

TAKING IT TO ANOTHER LEVEL

While Canada has a strong base of research excellence as well as broad strength in a range of disciplines, it cannot afford to rest on its laurels in the face of growing international competition. To remain competitive, Canada must take its research effort – including its university research effort – to another level.

This includes adding to "critical mass" in areas of particular excellence where Canada is or has the potential to become a world leader and where excellent research is important to addressing societal challenges. At the same time, it is essential to continue nurturing Canada's broad base of research strength.

- **AUCC recommends that in a federal research priority-setting initiative:**
 - **the priority areas should be defined broadly;**
 - **the social sciences and humanities should be active partners in the priority-setting process from the earliest stages; and**
 - **the government should work with the university research community, the private sector and the wider community in identifying areas of actual or potential research excellence.**

- **AUCC recommends building on the research strengths identified by the universities themselves as the basis for any federal priority-setting initiative.**

- **AUCC further recommends that the federal government, while pursuing promising areas of opportunity where it can achieve maximum impact, must also continue supporting quality research in a broad range of disciplines across the country. The training of the next generation of researchers and providing for**

the emergence of new areas of excellence will require continued nurturing of the solid base of research strength that Canada enjoys in a wide range of areas and ensuring that all regions have research capacity. Excellence and rigorous peer review must remain central to federal investments in research but, at the same time, research excellence is not associated only with some specific areas of research or geographical locations.

- AUCC strongly recommends that, in order to make it possible for Canada's research performing universities to support world class research excellence, the federal government reimburse indirect costs of federally-sponsored research through the Indirect Costs program at a minimum level of 40 percent for all institutions, while maintaining the sliding scale allocation formula.**
- AUCC supports the government's commitment in *Advantage Canada* to "(i)nvesting in research equipment and facilities in universities and colleges to compete with the best in the world" and strongly recommends that the government renew the mandate and funding of the Canada Foundation for Innovation.**
- AUCC recommends that, as part of the renewal of the mandate and funding of CFI, the government address on a priority basis the issue of operating funding to ensure the long-term sustainability of large-scale research infrastructure projects.**
- AUCC recommends that the federal government renew the mandate and funding of CANARIE. Given that the importance of CA*net 4 extends well beyond university research, it should be treated as fundamental knowledge infrastructure in the context of the government's development of a comprehensive plan for modern infrastructure.**
- AUCC recommends that federal regional development policies and agencies place particular emphasis on working with provinces, local communities and higher education institutions to facilitate the development of knowledge and innovation clusters that draw on the research expertise of universities. As well, the federal government can play an important role in stimulating clusters through investments in facilities for leading-edge collaborative research and commercialization.**
- AUCC supports the government's intent to build upon mechanisms such as the Networks of Centres of Excellence to strengthen links between postsecondary institutions and the private sector and recommends that an expansion or a rethinking of the NCE model be done in a balanced way that recognizes the importance of both business-led and university-led NCEs.**

DEVELOPING NEW RESEARCH TALENT

For Canada to compete in the internationally competitive global knowledge economy of the 21st century, it is imperative that the federal government work in partnership with the provinces and Canada's universities to develop new research talent and ensure that this new talent is being used to the fullest to promote economic growth and development. In the knowledge economy, research and analytical skills are critically important. The demand for advanced degree-holders is escalating. The private sector, in particular, will need to hire more people with research skills if business R&D and commercialization are to increase.

The number of graduate degrees awarded to Canadian students is not keeping pace with job growth and Canada has become increasingly reliant on immigration to meet the rising demand for knowledge workers. However, it is unlikely that Canada will be able to continue to rely on immigration to this extent in the face of growing international demand for HQP. Adding this new potential to the Canadian labour market will necessitate improvements to all aspects of the pipeline that brings advance degree holders into the labour market.

- **As the federal government considers how best to create a science and research culture in Canada, AUCC recommends that it work with the university community to build upon universities' current outreach efforts in this area. Universities are prepared to expand their outreach efforts to contribute to developing a research and science culture.**
- **AUCC recommends a federal initiative to provide talented undergraduate students with increased opportunities for research internship or co-op experiences in university, private sector or government research facilities over the course of their degree – with the most promising among them gaining more than one such experience to progressively build on their research skills.**
- **AUCC recommends that the federal government substantially increase its scholarship support for graduate students. This additional support should be delivered through the existing graduate scholarship programs of the three research granting agencies to avoid new administrative agencies or arrangements.**
- **AUCC recommends the creation of a flagship program of international graduate scholarships in numbers and at levels comparable to those offered by key competitor countries.**
- **AUCC recommends a research support initiative that would provide opportunities for greater numbers of graduate students to be actively engaged in the research conducted by their faculty mentors. Allocation would be through the three granting agencies and greater emphasis on the**

training of graduate students would be clearly identified in both their competitive peer review processes and year-end reporting.

- **AUCC recommends that the federal government make funds available to ensure that universities can provide growing numbers of graduate students with the infrastructure required for a high quality graduate education. This funding could be delivered through the Canada Foundation for Innovation and linked to actual growth in graduate enrolments.**
- **AUCC recommends that the federal government develop incentives for research internships and research-based co-op placements for recent graduates. These could take the form of competitive grants for university-based co-op and placement initiatives, and tax credits or salary subsidies to SMEs and other employers.**
- **AUCC recommends consideration of a program similar to the EU's Marie Curie Research Training Networks with a focus on providing young researchers with structured research opportunities in Canadian universities or other research organizations to help them to establish their research careers in Canada. Additionally, the federal government should increase support to the federal granting councils for the support of excellent young researchers.**

GETTING IT RIGHT

Maintaining Canada's position among world leaders in university research will require increased investments, but there is also a need to maximize the impact of these public investments and to provide for better measurement and reporting of results. While it is important to avoid radical "fixes" to a system that generally works very well, there is certainly room for improvement in some areas. In particular, there is a need to improve overall coordination within the portfolio of federal investments in university research to maximize effectiveness, efficiency and accountability in these strategically vital investments and to ensure that the university research effort, in cooperation with other partners and stakeholders in the S&T system, can make its fullest possible contribution in terms of excellence, productivity, and results for Canadians.

- **AUCC recommends that the four principal federal research funding agencies jointly exercise leadership in stressing change in organizational behaviour and culture to increase interagency collaboration. Government can contribute to this change through appropriate incentives and requirements for interagency cooperation. AUCC would not support a consolidation or forced merger involving the four principal agencies through which the federal government invests in university research.**

- **AUCC recommends that the heads of the four principal research funding agencies create a coordinating committee as the Irish agencies did in 2002, and meet regularly to address operational and other issues requiring ongoing coordination.**
- **AUCC recommends looking at the results of public investments in two broad categories:**
 - **“*First order*” results (the impacts of the investments on the quality and competitiveness of the university research environment); and**
 - **“*Second order*” results (the “products” of the university research environment, their transfer or translation to the wider community and the ultimate benefits they bring to the wider community).**
- **AUCC recommends the “agile” use of multiple evaluation tools, including both quantitative indicators and qualitative information, to measure success in relation to federal investments in university research and to inform policy development.**
- **AUCC supports the government’s intent to consider transferring the management of non-regulatory federal laboratories to universities but recommends that this consideration also include other ways of increasing collaboration such as further co-location of federal facilities on campuses where appropriate. AUCC recommends that this consideration include:**
 - **a systematic look at the range of arrangements already in place between universities and federal research facilities; and**
 - **an analysis of what is being done in other countries.**

It will be important to look for the management or co-location arrangements that are most appropriate in each situation and to avoid a “one-size-fits-all” approach.
- **AUCC further recommends that any transfer of management of federal labs to universities should include a clear understanding of the roles and responsibilities of each party and the requisite financial resources for the management and sustainability of the facilities over time.**

AUCC Submission to the Minister of Industry and the Minister of Finance on the Development of a Science & Technology Strategy for Canada

INTRODUCTION

In its economic plan, *Advantage Canada: Building a Strong Economy for Canadians*, the government notes that there is broad expert consensus on the determinants of long-term economic growth, including “a skilled and highly educated workforce” and “high rates of private and public investment in research and innovation.”¹ In short, investments in talent and in ideas are fundamental to economic growth, productivity and competitiveness.

University research accounts for more than one third of Canada's research effort, the highest proportion in the G8 countries. The federal government is the largest external investor in Canadian university research. Its portfolio includes investments in the four pillars of university research: production of new **ideas**; the development, attraction and retention of highly qualified research **talent**; cutting edge **research infrastructure**; and essential **institutional support** for the research effort.

This portfolio of research investments has become increasingly comprehensive and, in general, is very effective, enjoying wide support in the university research community. As a recent report by the Council of Canadian Academies suggests, Canada has broad-based strength in university research and is among the world leaders in research publication, despite increasing international competition. Given the importance of university research to Canada's overall research effort, this is very much a source of competitive advantage for Canada.

Advantage Canada commits to maintaining Canada's G7 leadership in public sector R&D investment, a very significant portion of which is university-based research. This will require increased investments in ideas and talent, as well as efforts to maximize the impact of government investments and ensure that the system of federal support is as effective, efficient and accountable as possible.

The importance of increased investments was acknowledged by the House of Commons Finance Committee in its recent report on its pre-budget consultations and the importance of maximizing the impact of government investments in research is emphasized in *Advantage Canada*: “Canadians have a right to expect that the greatest possible benefits are realized from these investments.”²

¹ *Advantage Canada: Building a Strong Economy for Canadians*, November 2006, p. 18.

² *Advantage Canada*, p. 59.

It is important to address these issues in the context of a coherent strategy to ensure that Canada remains among the world's leaders in university research. For this reason, AUCC welcomed the announcement in the May 2006 budget that the Minister of Industry, in collaboration with the Minister of Finance, will develop an S&T strategy for Canada. AUCC has prepared this submission as a contribution to the process of developing this S&T strategy.

The submission focuses on developing recommendations in three areas:

- ***Taking it to another level*** – the ways in which the government can identify areas of research excellence in which Canada can be a world leader, while at the same time continuing to nurture the country's broad base of research strength.
- ***Developing new research talent*** – the ways in which the government can promote a research and science culture and encourage more talented individuals to pursue advanced degrees and acquire the research skills and experience that employers in all sectors will require.
- ***Getting it right*** – the ways in which the government can maximize the impacts of the investments that are already being made in university research by ensuring better coordination amongst the various funding agencies, putting in place effective outcomes and accountability measures, and better linking research in universities and federal government facilities.

TAKING IT TO ANOTHER LEVEL

Advantage Canada notes that Canadians are highly educated and Canada leads in primary scientific research – strengths which, it notes, are among those that “provide the foundation for success in today’s global economy.”³ In its recent report entitled *The State of Science & Technology in Canada*, the Council of Canadian Academies points to Canada’s research strength across a broad array of disciplines, particularly as measured in terms of published research.⁴ Canada’s international research collaboration, as measured by the percentage of publications involving international co-publication activity, continues to grow steadily and exceeds the world average. Canada has the highest rate of international co-publication with the U.S. – the world’s largest producer of research – and is diversifying its co-publication activity through collaboration with researchers in Europe as well as emerging countries in Asia and in Central and South America.

Nevertheless, while Canada has a strong base of research excellence as well as broad strength in a range of disciplines, it cannot afford to rest on its laurels. More than ever, research and a highly-educated and skilled workforce remain the cornerstones of our country’s global competitiveness and its capacity to nurture innovation. Recognizing that world-leading R&D is driving sustainable economic growth, Canada’s traditional competitors in the OECD and emerging economies, such as China and India, have been significantly increasing their investments in R&D and higher education.

For example, US President George Bush announced in his February 2006 State of the Union Address an intent to double over ten year the budgets of key federal agencies that support basic research, representing an additional public investment of \$50 billion US over the decade.⁵ Many countries have set very ambitious GERD to GDP targets in recent years. For example, the European Union as a whole has a strategy in place to reach three percent by 2010, and this target has been replicated by most EU countries. China increased its R&D expenditures as a percentage of GDP by 37 percent between 2000 and 2004⁶ and has set ambitious targets to increase them even more in the coming years.

All of this has put additional pressures on the world demand for research and researchers and has accentuated the internationalization of research. To remain competitive, Canada must take its research effort – including its university research effort – to another level.

Identifying areas of strength where Canada can be a world leader

Advantage Canada indicates that among the ways the federal government will support research excellence is through “targeting new investments in R&D, including those

³ *Advantage Canada*, p. 19

⁴ Council of Canadian Academies, *The State of Science and Technology in Canada*, September 2006.

⁵ Due to confusion in the budget process for the current fiscal year, attributable in large part to the November 2006 mid-term elections, there has not yet been actual movement on this commitment. Nevertheless, the Democrats, who now control Congress, are committed to double funding for overall basic R&D.

⁶ Ministry of Science and Technology, People’s Republic of China, *S&T Statistics Data Book 2005*.

through the granting councils, to areas where Canada has the potential to be a world leader, such as energy, environmental technologies and health sciences.”⁷ Certainly, taking this country’s research effort to another level includes adding to "critical mass" in the areas of particular excellence where Canada is or has the potential to become a world leader and where excellent research is important to addressing societal challenges. At the same time, it is essential to continue nurturing Canada’s broad base of research strength.

Several countries have adopted R&D strategies that identify research areas where they can have a significant comparative advantage and where research can contribute major economic and social benefits. In Australia, for example, the government launched an extensive national consultation in 2002 to develop a set of national priorities. The intent was to better exploit Australia’s competitive advantages while achieving maximum value from the research investments. The Australian government established a set of four national research priorities (i.e. an environmentally sustainable Australia, promoting and maintaining good health, frontier technologies for building and transforming Australian industries, and safeguarding Australia) with a total of 17 goals, later increased to 21. The priorities and goals are broadly defined, thematic in nature, and very much multidisciplinary. Government research-performing and research funding organizations are expected to implement these national priorities and goals.

The Australian experience is instructive in several senses. Excessively narrow targeting can discourage the emergence of new, dynamic and multidisciplinary or cross-disciplinary approaches to issues. After the social sciences and humanities were largely left out of the first round of priority and goal-setting, the Australian government agreed to work with these research communities to refine the national priorities framework. This resulted in the addition of four new goals and various editorial enhancements to reflect a better balance between science and technology disciplines and the social sciences and humanities.

AUCC recommends that in a federal research priority-setting initiative:

- **the priority areas should be defined broadly;**
- **the social sciences and humanities should be active partners in the priority-setting process from the earliest stages; and**
- **the government should work with the university research community, the private sector and the wider community in identifying areas of actual or potential research excellence.**

With regard to the latter point, Canada’s size and diversity make a “top-down” approach to identifying research priorities quite unwise. In fact, in the area of university research, a “bottom-up” approach to priority-setting is already well-underway in this country. The Canadian system allows for substantial autonomy and flexibility, in which universities and researchers can be – and arguably, are – encouraged to be entrepreneurial and innovative in finding, creating, and pursuing opportunities. In part as a result of the requirements by both the Canada Foundation for Innovation and the Canada Research Chairs program that universities develop research plans, the institutions have been

⁷ *Advantage Canada*, p. 62.

encouraged to identify developing areas of strength – including areas that are relevant to the circumstances and economies of the regions and provinces, as well as national priorities.

AUCC has reviewed 69 of these institutional research plans. While the institutions identify a wide range of research strengths and priorities, consistent with the Council of Canadian Academies' finding that Canada enjoys research strength across a broad range of disciplines, it is also interesting to note that there is a strong correlation between areas of particular concentration across the institutional research plans and the four macro-areas of Canadian research strength identified in the CCA report – i.e., natural resources, information and communications technologies, health and related life sciences, and environmental S&T.

AUCC recommends building on the research strengths identified by the universities themselves as the basis for any federal priority-setting initiative.

AUCC further recommends that the federal government, while pursuing promising areas of opportunity where it can achieve maximum impact, must also continue supporting quality research in a broad range of disciplines across the country. The training of the next generation of researchers and providing for the emergence of new areas of excellence will require continued nurturing of the solid base of research strength that Canada enjoys in a wide range of areas and ensuring that all regions have research capacity. Excellence and rigorous peer review must remain central to federal investments in research but, at the same time, research excellence is not associated only with some specific areas of research or geographical locations.

Ensuring the conditions for research excellence

Federal investments in the indirect costs of research and in research infrastructure are crucially important if universities are to be able to support excellent research, including in some areas, world-leading research.

Fully supporting the indirect costs of research

Indirect costs of research are those costs associated with operating and maintaining research facilities (for example, laboratories, libraries and computer networks), managing the research process (research coordination, grant applications and management of intellectual property) and with regulation and safety compliance (human ethics issues, animal care, biohazards and environmental assessment). The federal government supports a portion of the indirect costs associated with federally-sponsored research through the Indirect Costs program.

One goal of the program is to provide universities with the means to make the best possible use of federal research funding by sustaining an internationally competitive research environment and providing researchers with the tools and support they need to

do their research effectively, productively, and in a financially and ethically sound manner. An internationally competitive research environment is a key factor in attracting and retaining top researchers who could easily move elsewhere.

A second goal of the program is to help smaller universities develop the capacity for their researchers to conduct quality research and compete effectively for federal research funding. Reimbursements for indirect costs are related to the direct cost base, which in turn reflects the success of universities in attracting funding on a competitive, peer-reviewed basis. The allocation formula is based on a sliding scale which recognizes that smaller institutions must incur proportionally larger baseline costs to support research.

AUCC supports the sliding scale allocation formula and strongly supports its continuation. However, it must be emphasized that at current levels of funding for the Indirect Costs program, there is only partial coverage of indirect costs for a significant number of institutions. To provide reimbursement at internationally competitive levels, the program would need to reimburse indirect costs at a minimum rate of 40 percent of direct costs for all institutions. Indirect costs are currently reimbursed at an overall average rate of 26 percent of direct costs – and for the institutions that are the largest research performers, the effective rate can be as low as 22 percent. This is inconsistent with a desire to ensure that Canadian universities can support research excellence at a world-leading level.

While excellent research is conducted at a wide range of institutions across Canada – large, medium and small – any initiative to take Canadian university research to another level and to provide the conditions for world-leading research must ensure that the country's largest research performers can support such research and compete for research talent on a global scale.

Indirect costs are also important for maximizing the benefits of research through applications and knowledge transfer. The program reimburses several types of costs which are incurred in building linkages and partnerships and in sustaining and strengthening networks and clusters that bring together researchers and companies.

Both research and the application of research take place in an increasingly competitive international environment. A number of Canada's key competitor countries have built high levels of support for indirect costs into their programs of research funding. For example, the US currently provides support at levels which are in the range of 52 percent of direct costs, on a cost base which also includes the relevant portion of the salaries of the principal researchers.

AUCC strongly recommends that, in order to make it possible for Canada's research performing universities to support world class research excellence, the federal government reimburse indirect costs of federally-sponsored research through the Indirect Costs program at a minimum level of 40 percent for all institutions, while maintaining the sliding scale allocation formula.

It is likely that such a measure would enjoy strong parliamentary support. The House of Commons' Standing Committee on Finance, in its annual pre-budget report, recently recommended that "the indirect costs of research (be) funded at a minimum rate of 40 percent for every dollar of federally sponsored research"⁸.

Supporting world class research infrastructure

Continued federal funding for cutting-edge research infrastructure is crucial for Canada's international competitiveness. In fact, intensifying international competition in infrastructure is a key element of the research environment – Australia's new National Collaborative Research Strategy is a good example. Infrastructure is a key component in any focused strategy designed to take Canada's research effort to another level. It is critically important to the productivity of researchers and the success of many of the projects for which they are receiving support. World class research infrastructure is essential for educating students, attracting and retaining researchers, and building "critical mass" in the context of research and innovation clusters. It can also serve wider communities through networking – for example, high performance computing and broadband networking are key to enhancing productivity and expanding the range of the research that can be done and the problems that can be solved in many fields.

The Canada Foundation for Innovation is the primary vehicle through which federal support for research infrastructure is delivered. It normally funds 40 percent of a project's costs with provincial governments, research institutions and private sector partners funding the remaining costs. CFI employs a rigorous competitive process that draws on top experts from across Canada and from abroad to assess project applications. As a result, CFI has funded a wide range of excellent and highly innovative research infrastructure projects. CFI is very much a Canadian success story that has attracted attention from around the world. With its current funding envelope almost exhausted, it is imperative that its mandate and funding be renewed.

The government's economic plan recognizes the importance of research infrastructure to attracting and retaining top researchers and to maintaining the competitiveness of Canada's research effort. **AUCC supports the government's commitment in *Advantage Canada* to "(i)nvesting in research equipment and facilities in universities and colleges to compete with the best in the world"⁹ and strongly recommends that the government renew the mandate and funding of the Canada Foundation for Innovation.**

Infrastructure can be fully and efficiently utilized only when the operating and maintenance costs are adequately covered. This has been a problem in Canada, particularly in relation to a number of the very large-scale research infrastructure projects that have been undertaken in recent years. CFI's Infrastructure Operating fund has been a partial source of such funding, but in general, the handling of operation and maintenance

⁸ House of Commons Standing Committee on Finance, *Canada: Competing to Win*, p. 137.

⁹ *Advantage Canada*, p. 52.

of these projects has been far too *ad hoc* with project managers sometimes forced to cobble together operating funding from a variety of sources on a short-term basis. **AUCC recommends that, as part of the renewal of the mandate and funding of CFI, the government address on a priority basis the issue of operating funding to ensure the long-term sustainability of large-scale research infrastructure projects.**

Beyond the research infrastructure funded through CFI, the federal government has also funded through the organization CANARIE the development and operation of CA*net 4, Canada's bandwidth network for research and education. While the seamless connectivity provided by CANARIE and CA*net 4 have significance well beyond the domain of university research, they are nevertheless a vitally important element of the research infrastructure that enables Canada's university researchers to participate fully in major collaborative scientific research projects nationally and internationally. CANARIE's funding and mandate are due to expire on March 31, 2007.

The initial announcement in the May 2, 2006 federal budget of the government's intent to develop an S&T strategy for Canada specifically indicated that the strategy will include "knowledge infrastructure."¹⁰ In a section on "modern infrastructure," *Advantage Canada* says that: "Infrastructure matters. Its financing, construction and maintenance are important areas where government can - and must - play a leadership role."¹¹ The plan commits the government to "work toward a comprehensive plan for infrastructure that includes long-term predictable funding,"¹² among other elements. While the discussion in this section of *Advantage Canada* is focused on infrastructure such as highways and border crossings, it should be emphasized that in a knowledge-based global economy, infrastructure such as CA*net 4 is absolutely crucial.

AUCC recommends that the federal government renew the mandate and funding of CANARIE. Given that the importance of CA*net 4 extends well beyond university research, it should be treated as fundamental knowledge infrastructure in the context of the government's development of a comprehensive plan for modern infrastructure.

Enhancing linkages between the universities and the private sector

In building excellence and maximizing the benefits of research, linkages are key. These include linkages among the researchers themselves, and also with those who apply and extend the results of the research, notably in the private sector.

Other countries have recognized the potential of public-private collaborations in research. For example, in 2002, the UK government commissioned an independent study on university-private sector collaboration. This study (known as the "Lambert Review"¹³)

¹⁰ *Focusing on Priorities: The Budget Plan 2006*, May 2, 2006, p. 85.

¹¹ *Advantage Canada*, p. 66.

¹² *Advantage Canada*, p. 69.

¹³ *Lambert Review of Business-University Collaboration: Final Report*, December 2003.

called for increased business relations with universities where the private sector would preferably be the instigator. It also recommended that business be more receptive to research from universities, that government increase its support for higher levels of business R&D in SMEs; that university funding be made more predictable; that government programs' objectives be simplified; and that programs be better marketed and their regional focus increased. A number of the recommendations have already been implemented.

Canada has made significant strides in recent years in developing research linkages between universities and the private sector. Canada is first in the G7 for the share of private sector research investments going to universities and second in the G7 for the share of university research funded by the private sector. Over the period 1996 to 2006, investments by the private sector in university research grew by 168 percent. Since 2001, the private sector has increased its investments in university research at a rate four times faster than investments in its own research.¹⁴

As well, positive strides have been made over the past few years with regard to technology transfer and the commercialization of university research. Universities have bolstered their capacity in this area through significant investments in their technology transfer offices and commercialization activities. As a result, they have made considerable progress on a number of commercialization-related indicators, including disclosures, new patent applications, numbers of spin-off companies and new licences. Universities' total income from the commercialization of intellectual property was more than twice as high in 2005 than it had been in 1999.

Despite these improvements, more can be done to enhance university-private sector linkages (as well as those with other organizations in the public and not-for-profit sectors), particularly in relation to knowledge transfer. The federal government can help to create the conditions for excellent research and knowledge transfer at the community level through policies to facilitate the emergence of knowledge and innovation clusters *and* across communities, provinces, regions and, indeed, internationally through policies to stimulate networks and collaboration. There are already examples of both types of initiatives in place, including the Networks of Centres of Excellence program, the NSERC Industrial Research Chairs, the SSHRC Community-University Research Alliances (CURAs), the clustering effects of CFI infrastructure funding, the Canadian Research Knowledge Network, and various international initiatives, including NEPTUNE.

In knowledge transfer and in applying the results of research, clusters are increasingly important, both in Canada and around the world. In 2003, there were already over 500 clustering initiatives worldwide.¹⁵ While much of the focus has been on clusters that have been built up within larger communities and regions (e.g. the Toronto and Montreal areas), it has still been possible for many smaller communities in Canada to create more

¹⁴ AUCC calculations using Statistics Canada data.

¹⁵ Manon Bourgeois and Mireille Brochu, *Conference Highlights – Clusters 2003: International Conference on Technology Clusters*, Nov. 7-8, 2003, Montreal, p. 5.

focused clusters in specific areas.

Universities play a key role in clusters, both through their regular programs and their research in general, and also through centres, institutes, and research and innovation parks that bring university researchers together with researchers and applications-focused personnel from other sectors. Investments in research infrastructure have, in many cases, been useful as "magnets" in helping to build up key research capabilities in areas important to the clusters.¹⁶ In their strategic plans, universities have given considerable attention to building and strengthening clusters, in the context of regional development, with a view to developing strengths in areas which could attract funding from CFI and the Chairs program, both of which require strategic plans.

In a number of other countries, including Britain and Sweden, there is a close relationship between clusters and regional development programs, with expenses for applications and development being treated as part of the regional development budget, with funding coming from the regional development authorities. **AUCC recommends that federal regional development policies and agencies place particular emphasis on working with provinces, local communities and higher education institutions to facilitate the development of knowledge and innovation clusters that draw on the research expertise of universities. As well, the federal government can play an important role in stimulating clusters through investments in facilities for leading-edge collaborative research and commercialization.**

Clusters can also be linked with other communities and with wider "communities of practice" through networks; and in that sense, networking and clustering initiatives are complementary.

Advantage Canada stresses the importance of linkages by proposing to strengthen "the links between universities, colleges and the private sector through mechanisms such as business-led Networks of Centres of Excellence to enhance the commercialization of Canadian ideas and knowledge."¹⁷ Since the inception of the Networks of Centres of Excellence (NCE) program in 1988, networking has become a key element of Canada's research and innovation policy. Over the years, close to thirty NCEs have emerged as convincing examples of how to mobilize scientific excellence between academia, federal and provincial departments and agencies, and the private sector through commercial objectives and public-private collaborations.

AUCC supports the government's intent to build upon mechanisms such as the Networks of Centres of Excellence to strengthen links between postsecondary institutions and the private sector and recommends that an expansion or a rethinking of the NCE model be done in a balanced way that recognizes the importance of both business-led and university-led NCEs.

¹⁶ Bearing Point Consulting, *Evaluation of the Innovation Fund, University Research Development Fund, and College Research Development Fund: Final Report*, May, 2003.

¹⁷ *Advantage Canada*, p. 62.

DEVELOPING NEW RESEARCH TALENT

For Canada to compete in the internationally competitive global knowledge economy of the 21st century, it is imperative that the federal government work in partnership with the provinces and Canada's universities to develop new research talent and ensure that this new talent is being used to the fullest to promote economic growth and development. *Advantage Canada*, acknowledges the importance of a highly educated workforce:

“Talented, creative people are a critical contributor to a successful national economy over the long term. Canada has a long and proud history of excellence and achievement in higher education, and Canadians have the skills needed to create high-quality, value-added products and services.”¹⁸

In the knowledge economy, research and analytical skills are critically important. The demand for advanced degree-holders is escalating. Between 1990 and 2005, the Canadian economy generated 500,000 new jobs for master's and PhD graduates – a 90 percent increase. On-going growth in the global knowledge economy will drive further increases in the demand for these most highly educated knowledge workers. The private sector, in particular, will need to hire more people with research skills if business R&D and commercialization are to increase.

The number of graduate degrees awarded to Canadian students is not keeping pace with job growth and Canada has become increasingly reliant on immigration to meet the rising demand for knowledge workers. From 1994 to 2005, the number of immigrants with master's degrees grew more than four-fold and those with PhDs more than doubled. It is unlikely that Canada will be able to continue to rely on immigration to this extent in the face of growing international demand for HQP.

The combination of this growing demand, increasing replacement demand, growing international demand and insufficient Canadian production of new advanced degree-holders poses a particularly pressing challenge for Canada in developing its Knowledge Advantage. An increasing proportion of the country's demand will necessarily have to be met by graduating more master's and PhD students in Canada. Adding this new potential to the Canadian labour market will necessitate improvements to all aspects of the pipeline that brings advanced degree holders into the labour market.

Developing a research and science culture

Increasing the private sector's research performance and commercialization in Canada will require increased awareness among private sector leaders of the value and potential of research to the success of their businesses. This will, in turn stimulate even more demand for highly qualified people with research skills. Attracting more people to

¹⁸ *Advantage Canada*, p. 53.

scientific and research careers to help meet this demand will require increasing young people's awareness of and interest in science and research. A key to all of this awareness raising is the development of a research and science culture in Canada, a task which must begin at an early age. The Minister of Industry recognized the importance of this issue when he recently mandated the National Science Advisor to "consider how to promote a strong culture of science, technology and innovation in Canada."

Universities across Canada already play an important role in engaging the public regarding the excitement and value of research through, for example, public lectures and youth outreach programs, often targeting underrepresented groups. To cite but a couple of examples, Brock University runs a program entitled *Scientifically Yours*, a three-day program for Grade 11 girls where participants live on campus and experience the sciences hands on, and *Centre d'études amérindiennes* at the Université du Québec à Chicoutimi operates the *Camp d'initiation scientifique* which offers a one-week summer camp for francophone Aboriginal high school students in the fields of science and arts. As well, all of the 29 members of Actua, Canada's leading science, engineering and technology youth outreach network, are located on university and college campuses across the country, providing young Canadians with positive, hands-on experiences that inspire them to become learners for life and develop self-confidence, creativity and critical thinking skills.

Outreach efforts by universities are not limited to engaging youth in science and research. For example, the Institute on Globalization and the Human Condition at McMaster University has as one of its goals the creation of dialogue between the university and the community on issues related to globalization. Every year, the institute puts on more than 20 public events that are well-advertised and draw large and diverse audiences.

Programs such as these, creating a public dialogue on science and research, are foundational in creating a science and research culture in Canada. More can be done. **As the federal government considers how best to create a science and research culture in Canada, AUCC recommends that it work with the university community to build upon universities' current outreach efforts in this area. Universities are prepared to expand their outreach efforts to contribute to developing a research and science culture.**

Providing undergraduate research experiences

Nurturing and exposing undergraduates to the world of research is essential to increasing the number of people who actually pursue graduate studies. As *Advantage Canada* acknowledges:

"The Government's investments in university research help create an environment in which Canada's needs for highly skilled graduates can be met. A first-class education at this level depends on the quality of facilities, instructors and experience provided to young Canadians....Federal granting councils fund

projects that provide students with opportunities to work with the best minds and participate in groundbreaking research. This experience prepares students to add tremendous value to Canadian businesses, health science centres, and Canada's health, social service and other organizations once they graduate. Practical internships also offer young people superb learning opportunities in important sectors of our economy."¹⁹

Increasing efforts to bridge teaching and research and offering opportunities for research engagement to promising undergraduate students will help undergraduate students become well prepared to undertake graduate studies. Undergraduate awards offered by the granting agencies can be a good way to provide students with exposure to research and an understanding of the benefits of graduate studies and a research career.

AUCC recommends a federal initiative to provide talented undergraduate students with increased opportunities for research internship or co-op experiences in university, private sector or government research facilities over the course of their degree – with the most promising among them gaining more than one such experience to progressively build on their research skills.

An initiative of this type would need to be developed in conjunction with the research granting agencies in order to build, to the extent possible, on existing programs of this nature and could be administered through the granting agencies.

Providing more opportunities for talented students to pursue graduate studies

The talents, knowledge and skills of master's and doctoral graduates are key drivers of the knowledge economy. It is therefore not surprising to find that the demand for research and analytical skills of advanced degree-holders is escalating in all regions of the country. Yet, as noted earlier, [Canada's production of advanced degrees is not keeping pace with job growth](#). Furthermore, Canada's key international competitors are awarding proportionally more graduate degrees. For example, in 2003, American universities awarded twice as many master's degrees per capita and almost one third more doctoral degrees per capita. Closing this gap is a major competitive challenge for this country.

It is very important to expand the opportunities available to Canadians to access and complete graduate programs in Canada. In part, this will require measures to address affordability concerns. Affordability at the graduate level is even more complex than for undergraduate students. After having completed bachelor's or even master's degrees, the graduates are much more employable and at much higher income levels. In other words, their opportunity costs are considerably higher. In addition, many prospective graduate students will have accumulated debt in their earlier studies and may be quite averse to accumulating more debt when employment opportunities beckon.

¹⁹ *Advantage Canada*, p. 52.

Scholarships provide one vehicle to help graduate students to overcome both opportunity costs and the prospects of accumulating debt while pursuing advanced studies.

Advantage Canada commits to increasing scholarship support for graduate students.

AUCC welcomes this commitment.

AUCC recommends that the federal government substantially increase its scholarship support for graduate students. This additional support should be delivered through the existing graduate scholarship programs of the three research granting agencies to avoid new administrative agencies or arrangements.

Canada's efforts to grow graduate student enrolment should not be limited to the domestic student market. *Advantage Canada* also makes reference to attracting and retaining the best and brightest students from around the world. To ensure that Canada can effectively compete for excellent students in a globally competitive market, it must become a destination of choice. An essential element in becoming a destination of choice, as is evident in other OECD countries' approaches to education marketing, is the offering of prestigious international graduate scholarships.

Australia is internationally recognized for its concerted approach to attracting global talent. Its nationally-led marketing campaign is underpinned by a suite of prestigious scholarships. Through these *Australian Scholarships*, they will distribute over \$1.2 billion CAN over five years, with the intent of attracting more than 19,000 top flight graduate and post-doctoral students from around the world to Australian universities. In addition to its famous *Rhodes Scholarships*, the UK began in the 1990s to put in place a range of measures to ensure that its universities attract a growing share of global talent. The *Chevening Scholarships*, funded by the Foreign and Commonwealth Office at approximately \$70 million CAN per year, support about 2,300 students from 150 countries each year to pursue postgraduate studies and research at UK institutions of higher education. Moreover, the April 2006 announcement of the Prime Minister's Initiative for International Education aims to attract an additional 100,000 international students through a variety of marketing and promotion activities.

AUCC recommends the creation of a flagship program of international graduate scholarships in numbers and at levels comparable to those offered by key competitor countries.

Scholarships can play an important role in attracting more students into graduate studies, but one of the best predictors of graduate students' success, and a key factor in improving completion rates and shortening time-to-degree, is the level of interaction with faculty. This allows for a better integration of students' projects with established research programs and increases the level of faculty mentoring that students receive.

AUCC recommends a research support initiative that would provide opportunities for greater numbers of graduate students to be actively engaged in the research conducted by their faculty mentors. Allocation would be through the three granting

agencies and greater emphasis on the training of graduate students would be clearly identified in both their competitive peer review processes and year-end reporting.

Also, given the need identified above to expose more undergraduates to research experiences, it may be desirable to ensure that research grant applicants are encouraged to include the research training of undergraduate students, as well as graduate students, in their research proposals.

Finally, providing increased opportunities for talented students to pursue and benefit from graduate studies must also involve ensuring that the universities have the necessary infrastructure to meet the needs of growing numbers of graduate students. Laboratory, research and office space for graduate students, research support staff and university faculty is some of the highest cost space that universities encounter when they are constructing new facilities.

While individual institutions may have limited amounts of underutilized capacity, this would be very rare. For example, data on the Ontario system in 2004-05 illustrated that universities had only 73 percent of the space they required to meet international space standards for existing student and faculty. Clearly, accommodating additional graduate students and faculty will require expanding university facilities.

AUCC recommends that the federal government make funds available to ensure that universities can provide growing numbers of graduate students with the infrastructure required for a high quality graduate education. This funding could be delivered through the Canada Foundation for Innovation and linked to actual growth in graduate enrolments.

Given that there are significant differences in the costs of infrastructure by area of specialization, growth in various areas of specialization would need to be factored into the allocation mechanism. Research space for undergraduate students would also need to be taken into consideration.

Providing opportunities for young researchers

It is important that all young researchers, once they graduate from university, are able to make a successful transition into the workforce. There is increasing international competition for excellent young researchers. If Canada is to retain its young talent, it must be able to compete successfully with other countries which are targeting various incentives at these individuals to help them establish their research careers.

For example, a number of countries employ tax credits or other subsidies as incentives for the employment of research personnel. Belgium is reducing social security taxes on the salaries of scientific researchers for companies that undertake collaborative R&D projects with universities. In France, an additional tax credit is granted to companies to offset twice the cost of the first year of employment for PhD graduates. Hungary offers

tax-free employment of students up to a certain limit per month and Korea provides small and medium-sized businesses with subsidies for employing R&D personnel.

Advantage Canada recognizes the important role that university-trained researchers play in knowledge transfer in the Canadian economy:

“The research undertaken at Canadian universities creates new ideas and technologies that enrich our economy and society. Internationally renowned Canadian research in fields such as health, information and communications technologies, energy and environmental technologies helps to solve social and environmental problems. As recent graduates enter the labour market, they transfer this new knowledge from universities to businesses. World-class Canadian research also creates exactly the kinds of jobs we need to be a leader in key economic sectors.”²⁰

Creating opportunities for more advanced-degree holders to work in research or research-related positions in the private sector not only helps these young researchers establish their careers and gain important business experience, but also provides businesses with access to the research expertise of the young researchers and their networks and exposure to new and innovative ideas and approaches. This can be particularly important in helping to develop research capacity and receptor capacity in small and medium-sized businesses.

There are a number of examples of internships or co-op placements for young people with research skills within particular university programs in Canada. However, these programs tend to lack sufficient resources and do not attract enough business hosts. Incentives directed to these areas by the federal government could be beneficial in increasing valuable opportunities for students and the private sector, as well as other employers such as community-based organizations that can benefit from research expertise.

AUCC recommends that the federal government develop incentives for research internships and research-based co-op placements for recent graduates. These could take the form of competitive grants for university-based co-op and placement initiatives, and tax credits or salary subsidies to SMEs and other employers.

It is also important to ensure that highly talented young researchers who wish to pursue university research careers have the necessary incentives to stay in Canada where they are crucial to the rejuvenation and regeneration of research talent in this country’s universities. The European Union supports the Marie Curie Research Training Networks as part of its training, mobility and career development framework. These Networks provide training and research experiences for researchers of any age or nationality by giving them the opportunity to spend between three months to three years in another country as part of an international high-quality research project. The networks contribute to the transfer of knowledge through the promotion of multidisciplinary research.

²⁰ *Advantage Canada*, p. 60.

Among the array of programs supported by the Networks is the Marie Curie Fellowships for Early Stage Research Training which makes funding available not only for universities but also for other research organizations and businesses in the EU or associated states to provide early-stage researchers of any nationality or age with structured scientific or technological training opportunities of three months to three years in duration. A similar program should be considered for this country but with an in-Canada focus.

AUCC recommends consideration of a program similar to the EU's Marie Curie Research Training Networks with a focus on providing young researchers with structured research opportunities in Canadian universities or other research organizations to help them to establish their research careers in Canada. Additionally, the federal government should increase support to the federal granting councils for the support of excellent young researchers.

GETTING IT RIGHT

Maintaining Canada's position among world leaders in university research will require increased investments of the type outlined in the earlier sections of this brief, but as *Advantage Canada* stresses, there is also a need to maximize the impact of these public investments and to provide for better measurement and reporting of results. While it is important to avoid radical "fixes" to a system that generally works very well, there is certainly room for improvement in some areas. In particular, there is a need to improve overall coordination within the portfolio of federal investments in university research to maximize effectiveness, efficiency and accountability in these strategically vital investments and to ensure that the university research effort, in cooperation with other partners and stakeholders in the S&T system, can make its fullest possible contribution in terms of excellence, productivity, and results for Canadians.

*Increasing collaboration among federal funding agencies*²¹

The current portfolio of federal research investments and programs was built up incrementally over time as specific needs and opportunities were identified, rather than as part of a full-blown plan thought out in advance. It is important to ensure that these investments and programs are mutually complementary and delivered efficiently and effectively. To this end, the May 2006 federal budget included a commitment to "undertake a review of accountability and value for money of the granting councils' activities,"²² in conjunction with the development of an S&T strategy for Canada.

The four principal agencies that administer federal investments in university research are the Canada Foundation for Innovation, Canadian Institutes of Health Research, Natural Sciences and Engineering Research Council and Social Sciences and Humanities Research Council. The current system works well on an agency-by-agency basis, but there is a need for increased coordination across and between the four funding agencies – in the space between them – in order to ensure that:

- there are no major funding gaps that threaten effectiveness or sustainability;
- the programs do not overlap in ways that undermine efficiency and effectiveness at both the agency and university levels;
- they facilitate excellent research including, multidisciplinary research;
- they enable and encourage knowledge transfer; and
- there are suitable provisions for public accountability and reporting of results.

At present, some subjects and problems – such as operating costs for infrastructure – fall between the funding agencies and have either not been addressed in a concerted way or have been addressed on an ad hoc basis. In addition, the diversity of funding programs administered by the agencies has contributed to a proliferation of application and

²¹ A more in-depth discussion of this subject is contained in *Maximizing Efficiency, Effectiveness and Accountability in the System of Federal Support to University Research in Canada: An AUCC Discussion Paper*, December 2006.

²² *The Budget Plan 2006: Focusing on Priorities*, May 2, 2006, p. 85.

reporting processes which have added to the administrative burden on both the agencies and the universities. There is a need to streamline application and reporting processes across agencies and programs in the interests of enhanced efficiency, effectiveness and accountability. As well, there is a need for ongoing assessment of the combined impact of programs and the relationships and synergies among them in order to maximize the total benefits from the agencies' activities.

One approach to increasing coordination would be to stress structural consolidation, particularly through mergers of agencies or making a small number of agencies responsible for funding research across very broad disciplinary groupings. In *Advantage Canada*, the government indicates that its plans to maximize the impact of its research investments include "consolidating the range of available funding mechanisms,"²³ but it is unclear whether this would include mergers of agencies. International experience in this area is mixed, including some countries that are good comparators for Canada.

Australia, for example, has only two granting councils – the National Health and Medical Research Council and the Australian Research Council, which includes the NSERC and SSHRC disciplines. In the United Kingdom, on the other hand, the Conservative government of John Major considered reducing the number of research funding agencies in the early 1990s but opted to continue with separate, smaller councils with precisely focused missions. Indeed, the Major government added a sixth council to those already in existence. That number has since increased to eight, one of which plays an important cross-cutting role in working with the other councils to set future priorities for the UK's scientific needs and deliver high quality facilities for academic and industrial research.

Ireland has also grown the number of research funding agencies in recent years. As part of its strategy to develop R&D capacity, the Irish government added two new councils – the Irish Research Council for the Humanities and Social Sciences in 2000 and the Irish Research Council for Science, Engineering and Technology in 2001 – to several existing research funding agencies including, among others, the Health Research Board and the Higher Education Authority's Programme for Research in Third Level Institutions. In 2000, the government also created Science Foundation Ireland to fund research that underpins biotechnology and information and communications technology, in particular.

In theory, at least, a full-scale merger of the four major funding agencies at the federal level in Canada could provide benefits such as focused accountability through having a single minister report to Parliament; streamlined application and reporting processes with accompanying administrative cost savings at both the university and agency levels; reduced impediments to the support of cross-cutting, multidisciplinary research; and ease of partnering with the private sector, the not-for-profit sector and the universities themselves by virtue of having a single interlocutor at the federal level.

However, there are very significant obstacles and costs associated with a full-scale merger, as well as real advantages to maintaining separate agencies:

- CIHR reports to Parliament through the Minister of Health, while the other three

²³ *Advantage Canada*, p. 59.

- agencies report through the Minister of Industry;
- CFI's legal status as a non-profit foundation is very different from that of the three granting agencies;
 - each of the three granting agencies has its own strategy and method of operating adapted to the needs and realities of the disciplines concerned and widely supported in their respective research communities, while CFI has developed its own methods particular to the cross-cutting infrastructure needs that it meets;
 - there are advantages in the agencies' having focused missions, which would be lost as the combined agency struggles to devise ways of recognizing different needs across discipline areas;
 - a "mega-agency" would lack the flexibility and agility that a more focussed agency can provide;
 - a merger would take time, slow down the consideration of new proposals, involve significant administrative costs, and inevitably generate a measure of dislocation and conflict as organizations with different cultures, modes of operation and clientele are forced together; and
 - approaches to knowledge transfer differ between areas of knowledge and each of the funding agencies has developed its own approach to knowledge transfer, working from the needs of the users.

A partial merger of NSERC and SSHRC might be more easily achieved because they are similar federal agencies reporting to Parliament through the same minister, but they fund research in very distinctive disciplinary areas. Such a merger would suffer from the problem of diverting the agencies' focus for a period of time from the consideration of new proposals and would still leave the problem of managing the space among agencies (albeit three instead of four), and hence would be no solution at all in this respect. In short, there is a real risk that a merger of agencies would create more problems than it would solve.

AUCC recommends that the four principal federal research funding agencies jointly exercise leadership in stressing change in organizational behaviour and culture to increase interagency collaboration. Government can contribute to this change through appropriate incentives and requirements for interagency cooperation. The goal would be to provide the conditions for ongoing and systematic interagency collaboration and programming without the disruptions and potential costs associated with forced mergers and without creating a new bureaucracy. AUCC would not support a consolidation or forced merger involving the four principal agencies through which the federal government invests in university research.

Canada already has a good base of interagency cooperation upon which to build. There is substantial ongoing informal contact, consultation, and coordination among the four agencies. Several major initiatives are administered on a tri-agency basis – most notably, the NCEs, the Canada Research Chairs program, and the Indirect Costs program. As well, among NSERC, SSHRC and CIHR, there are more formal examples of tri-agency cooperation in the administration of research funding – for example, the working group that developed the Memorandum of Understanding on Roles and Responsibilities in the

Management of Federal Grants and Awards, and the tri-agency Panel on Research Ethics. In addition, various CFI initiatives – such as the International Joint Venture Fund, the Leaders Opportunity Fund, and the National Platforms Fund – have all involved cooperation and coordination with the granting agencies.

Canada can also learn from other jurisdictions that have confronted a similar challenge. The United Kingdom has opted for more institutionalized coordination through the creation of Research Councils UK. The heads of the research councils meet monthly as the RCUK executive group to address administrative, operational and strategic matters. On a quarterly basis, they also meet collectively with ministry officials to discuss high-level strategic issues. They are supported by a small secretariat (14 persons) seconded from the individual councils. The total cost of running RCUK is \$800 K for a research effort that is nearly twice as large as Canada's. For the research councils, coordination through RCUK has now become a standard way of doing business.

In Ireland, four funding agencies agreed in 2002 to work together to maximize their contribution to building world class research capacity in Ireland. They created a standing committee of the research funding bodies, made up of their chairs/chief executives, “to ensure coordination and coherence in process, planning and scheduling and the exploitation of inter-programme complementarities.”²⁴ Informally known as the “Merrion Group,” the original four agencies, together with several others that were added later, continue to meet and provide operational coordination. The committee has no permanent staff or budget. At the strategic level, a newly-created Higher Education Research Group brings senior executives from the funding agencies together with representatives from the main departments responsible for university research.

One option for ongoing coordination in the Canadian context would be to create an RCUK-type organization comprising the heads of the four main federal research funding agencies. Like RCUK, it could have a small staff seconded from the agencies and a small operating budget. However, for many in government and the university research community, another structural solution involving the creation of a new agency, even one limited in staff and budget, is not an appealing option at this point in time.

A more promising alternative is for the agency heads themselves to send a strong signal that they are committed to creating a culture encouraging and rewarding effective, ongoing and systematic coordination among the four agencies, while still respecting their individual mandates. To this end, **AUCC recommends that the heads of the four principal research granting agencies create a coordinating committee as the Irish agencies did in 2002, and meet regularly to address operational and other issues requiring ongoing coordination.**

The government could help make this happen through creating the conditions and incentives to encourage teamwork and coordination rather than interagency competition, with a focus on practical, tangible, and measurable results. For example, the government could designate a portion of additional future investments for cross-cutting initiatives

²⁴*First Report of the Research Funding Bodies*, July 2003, Appendix 1: Co-operation Agreement, p. 9.

developed by the funding agencies working together and subjected to peer review to ensure excellence. If these were truly new investments, they could provide a powerful, positive incentive for excellent multidisciplinary projects drawing on the strengths of all the agencies and their research communities.

As well, the government could signal an expectation that the three granting agencies' strategic plans will include increased emphasis on interagency collaboration, backed up by a systems-level approach to evaluation. A similar expectation of increased collaboration could be included in funding agreements between the government and CFI.

Measuring success in relation to federal investments in university research²⁵

The traditional approach to assessing the research enterprise is through the lens of inputs, outputs, outcomes and impacts. Input and output indicators are often used as short-term proxies for the eventual long-term impacts of research investments. While input and output measures are fairly well documented and readily available, specific indicators relative to the concepts of outcome and impact are more problematic. Definitions are often inconsistent; and the lines between outcomes and impacts are often blurry.

Furthermore, research outcomes and, in particular, the socio-economic impacts of research tend to be only indirectly linked to specific research projects and investments. While some impacts can be directly traced back to particular research discoveries – e.g. the impact of the discovery of insulin on life expectancy and quality of life for diabetics – impacts are more often discussed in aggregate terms – e.g. competitiveness, productivity, standard of living and ultimately, quality of life – where the links back to public investments and the research they support are more indirect, though no less important.

The definitional and methodological challenges are real; and the complexities involved in measuring results suggest a need for multiple measures and for the use of a combination of quantitative indicators and qualitative information, as well as great care in interpreting various measures and rigorous attention to the context in which the measures are applied.

The challenges do not, however, provide a good reason to avoid demonstrating results for public investments in university research. As these investments increase, governments want to see results and they want to be able to assess their countries' relative performance. The challenge is to find practical, meaningful ways of measuring success in relation to these public investments.

Rather than employing the traditional input/output/outcomes/impacts categories with their definitional and methodological problems, **AUCC recommends looking at the results of public investments in two broad categories:**

- ***“First order” results (the impacts of the investments on the quality and competitiveness of the university research environment); and***

²⁵ A more in-depth discussion of this subject is contained in *Measuring Success in Relation to Federal Investments in University Research: An AUCC Discussion Paper*, November 2006.

- **“Second order” results (the “products” of the university research environment, their transfer or translation to the wider community and the ultimate benefits they bring to the wider community).**

The two categories are inter-connected, as a quality research environment is a pre-requisite for good second order research results; and a good record of second order results help to attract the right resources and create the right linkages to create a quality environment.

It is important to resist the temptation to search for the “magic bullet” indicator that would allow measurement of progress for each incremental dollar of public investment. When used in isolation, quantitative indicators offer a narrow and fragmented view of the world. **AUCC recommends the “agile” use of multiple evaluation tools, including both quantitative indicators and qualitative information, to measure success in relation to federal investments in university research and to inform policy development.**²⁶

Indicators to assess *first order results* include both traditional input indicators and a number of other indicators that are specific to the university research environment. It would be possible to set targets over time on a number of these indicators as well as measure the progress made towards meeting those targets.

- *Funding* – Competitive funding of the research environment is essential to international competitiveness. While not without problems, such measures as GERD to GDP and HERD to GDP still provide a useful basis for international comparisons.
- *Graduate enrolment and international graduate enrolment* – Graduate students are an important part of the institutional research environment. The ability to attract them from abroad is a good indication of how Canada’s higher education and research environment is perceived abroad.
- *Attraction and retention of researchers* – Canadian universities’ collective ability to retain researchers and to attract researchers from abroad is one indication of how our research environment is perceived.
- *Co-authorship* – Collaboration is now an essential part of a successful research environment. Co-authorship data provide one indication of overall trends in this area.
- *Private sector investments in university research* – The ability of universities to attract funding from the private sector is indicative of how the university research environment is perceived by the private sector. Contract

²⁶ In 2005, AUCC reported on universities’ collective research performance in a report entitled *Momentum: The 2005 report on university research and knowledge transfer*. The report used both quantitative measures and qualitative information.

research and collaborative projects are important indicators of the linkages that exist between the two sectors.

- *International research funding* – Universities’ combined success in obtaining competitively-allocated research grants from abroad provides an indicator of the overall quality of the Canadian university research environment.

With regard to measuring *second order results*, universities transfer knowledge in many ways, including the production of highly qualified graduates, publications, presentations, expert advice and consulting, community service and outreach, public policy engagement, commercialization activities and cross-sectoral partnerships, among others. Together, they lead to substantial benefits for individuals, communities and cities, provinces, regions, and the country as a whole.

Data are readily available in Canada and abroad for graduate degrees awarded, publications, commercialization activities and, to some extent, cross-sectoral partnerships, but not for measuring the results of the other types of knowledge transfer activities. Nevertheless, any accounting for universities’ contributions to the wider society must try to capture these contributions in qualitative terms where quantitative measures are not available.

- *Graduate degrees awarded* – Degrees awarded at the graduate level are a major “product” of the university research effort, and are a good indicator of the results of public sector investments in university research and of Canada’s relative performance internationally.
- *Publications and Citations* – While not without weaknesses, publications and citations data can provide useful indicators for comparing trends in national research output.
- *Commercialization* – Used with care, data on revenues, patents and spin-offs can provide useful indicators of the overall level of commercialization of university research.
- *Cross-sectoral partnerships* – Considerable knowledge transfer occurs through research collaboration between universities and other sectors, notably the private sector. Federal research investments help to create university capacity to engage in such activities.
- *Economic impact* – While it is extremely difficult to show direct links between specific research investments and measurable improvements in the economy or quality of life, macroeconomic impact studies have been the basis for government investments in research for more than half a century and, given their total factor approach, continue to provide a sophisticated demonstration of the overall link between university research (and universities more generally) and economic growth.

Transferring management of federal laboratories to universities

In *Advantage Canada*, the government indicated that its plans to increase the impact of public investments in R&D include “considering transferring the management of some non-regulatory federal laboratories to universities in order to lever university and private sector strengths, create better learning opportunities for students and foster research excellence.”²⁷

The practice of having universities manage government labs is well established in various countries, including the United States where management and operation of several key national laboratories have been contracted out to the university, private and not-for-profit sectors. This was done in recognition of the benefits that such partnerships would bring to the research enterprise and its results. In 2004, research activities in the Federally-Funded Research and Development Centres (FFRDCs) administered by universities and colleges in the US were worth \$7.5 billion.²⁸

In Canada, the federal government and the universities are already engaged in a fairly extensive range of collaborations involving the hosting of federal research facilities on-campus; affiliation between universities and federal research facilities located off-campus; or joint research facilities (sometimes involving provincial or private sector partners as well). A preliminary survey of AUCC member institutions suggests that there exist more than 70 such arrangements involving at least 30 universities and employing more than 3,000 individuals from federal and provincial governments, universities and other sectors. More than half of these are federal research facilities hosted on campuses or affiliated with universities while the rest are joint research facilities between the federal government and the universities (and, in some cases, other partners).²⁹ In the absence of a national policy regarding such facilities, a range of financial and managerial arrangements have developed and continue to develop between the federal government and universities.

The federal government’s research activities and those of universities fulfill quite different roles and there are certainly important differences in their approaches – e.g. the universities’ much greater emphasis on peer review to ensure research quality, and on publication in peer-reviewed journals to disseminate research results. Nevertheless, there are also real possibilities for research collaboration that can benefit both university research and government research. Co-location of federal facilities on campuses, joint management of research facilities or activities and, in some cases, transfer of the management of federal research facilities to universities all hold potential benefits for the two research enterprises, and ultimately for the public.

The extent to which federal research activities are already being conducted on campuses across the country is a clear sign that both parties see these partnerships as beneficial.

²⁷ *Advantage Canada*, p. 60.

²⁸ National Science Foundation, *Science and Engineering Indicators 2006*.

²⁹ The National Research Council is involved in the largest number of federal facilities on university campuses followed by Agriculture and Agri-Food Canada, Environment Canada and Statistics Canada.

There is certainly room for more such decentralization. AUCC reported in 2005 that while Canada's overall research effort is heavily concentrated in Ontario and Quebec, this concentration is most pronounced in the private sector (almost 84 percent in Ontario and Quebec, more than 15 percent in the western provinces and less than one percent in the Atlantic) and federal government research (more than 78 percent in Ontario and Quebec, particularly the National Capital Region, and just over 14 percent and seven percent in the western provinces and the Atlantic, respectively). By comparison, less than 68 percent of university research took place in Ontario and Quebec, with more than 26 percent in the western provinces and just under six percent in the Atlantic.³⁰

AUCC supports the government's intent to consider transferring the management of non-regulatory federal laboratories to universities but recommends that this consideration also include other ways of increasing collaboration such as further co-location of federal facilities on campuses where appropriate. AUCC recommends that this consideration include:

- a systematic look at the range of arrangements already in place between universities and federal research facilities; and
- an analysis of what is being done in other countries.

It will be important to look for the management or co-location arrangements that are most appropriate in each situation and to avoid a "one-size-fits-all" approach.

AUCC further recommends that any transfer of management of federal labs to universities should include a clear understanding of the roles and responsibilities of each party and the requisite financial resources for the management and sustainability of the facilities over time.

³⁰ AUCC, *Momentum: The 2005 Report on University Research and Knowledge Transfer*, pp. 13-14.