

**Networks of Centres of Excellence  
International Advisory Committee**

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Recommendations on the Future  
Direction of the NCE Program



**August 2007**



Networks of Centres  
of Excellence of Canada

Réseaux de centres  
d'excellence du Canada

**Canada**



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## FOREWORD FROM THE CHAIR

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The Networks of Centres of Excellence (NCE) program is embarking on a period of renewal. For more than 18 years, the NCE program has successfully brought together the best minds in all disciplines and all sectors to address problems critical to Canada. Today, the NCE program networks are leading the world in new research in diverse fields from stroke treatment and prevention to mathematics for information technology and complex systems applied in Canadian industry. While once unique, the NCE program is now emulated by others. Our challenge in Canada is thus to think about the next 20 to 25 years and how best to further enhance the NCE program. As such, it was my pleasure to act as Chair of the NCE International Advisory Committee (NCE-IAC) established by the NCE Steering Committee to review this key Canadian science and technology (S&T) funding program.

This review is timely, as it comes at a stage when the Government of Canada is renewing and refocusing its commitment to funding S&T research to help Canada continue to prosper and build its reputation as a world leader in S&T. In November 2006, the federal government launched its national economic plan entitled *Advantage Canada: Building a Stronger Economy for Canadians*. The federal government stated its commitment to support direct research investments that will improve the quality of life of all Canadians. The Government of Canada recognizes the role that the NCE program plays in moving research from academia to relevant stakeholders for their use in order to achieve social and economic benefits for Canadians. Within the *Advantage Canada* plan and in the 2007 federal budget, the government has committed additional funding to increase the role of the NCE program in achieving these outcomes, with a particular focus on increasing involvement from the private sector. The goals set out in *Advantage Canada* are further supported by S&T priorities recently described in *Mobilizing Science and Technology to Canada's Advantage*, Canada's new, comprehensive national S&T framework.

It is within this context that the NCE-IAC undertook the challenge to look at the NCE program and provide advice and recommendations on how it can be enhanced to support Canadian researchers, the private sector, and other stakeholders in their drive to deliver new S&T to support Canada and Canadians.

The members of the NCE-IAC are international leaders, from various sectors and disciplines, with in-depth experience not only in the establishment of programs similar to the NCE program but also in their evaluation and renewal. The NCE-IAC members reviewed extensive background material and travelled to Ottawa from across the globe to share their experiences in person, and to discuss and deliberate on the future direction for the program. As Chair of the NCE-IAC, I have been impressed with the members' preparedness, their knowledge of the NCE program, their dedication to its goals, and the application of their expertise—forged on the international stage—to the review of the NCE program. I would like to personally thank them for their full involvement in the deliberations of the NCE-IAC.

## FOREWORD FROM THE CHAIR

The NCE-IAC received input from a wide variety of sources including NCE program stakeholders such as NCE Steering Committee members, NCE Scientific Directors, NCE Boards of Directors, university and network partners, and the assistant deputy ministers (ADMs) of several federal government science-based departments and agencies (SBDAs). I would also like to thank them for their active involvement in the overall process.

The NCE program is one that the NCE-IAC feels will continue to be an international model for collaborative research. From the International Advisory Committee's (IAC's) perspective, there is no doubt that this program will continue to be of value to Canadians as measured by societal benefits, and especially the impacts on productivity and competitiveness through the development of a strong research base.

As the Chair of the NCE-IAC, I would like to commend the NCE Steering Committee on its decision to engage the IAC and welcome its receptiveness to the recommendations that have resulted from this process. I encourage the Steering Committee to repeat the international review process in the future as the NCE program continues to grow and mature. Additionally, I would like to especially acknowledge the work and the support of the NCE Secretariat and NIVA Inc. who were involved in the development of this report.

The NCE-IAC looks forward to the growth of the NCE program in the future, a future in which Canada will continue to prosper and grow as its reputation as a source of leading-edge S&T research and development at home and abroad is still further enhanced.

**Dr. Roderick D. Fraser**  
Chair, NCE-IAC

## EXECUTIVE SUMMARY

The NCE program has profoundly transformed the way research is done in universities and has pioneered innovative ways to translate research into economic growth and social progress. By bringing together research and collaboration, NCE networks provide an internationally competitive environment for Canadian researchers and students to work together with user sectors, and accelerate the exchange of knowledge and transfer of new technology to the private sector and other user communities.

Today, nearly two decades since the program's inception, NCE networks continue to deliver powerful solutions to Canada's problems; the program remains a key component of the Government of Canada's S&T agenda. In the 2007 budget, the federal government not only renewed the NCE's annual funding, it dedicated \$11 million in 2008–09 to accelerate the creation of up to five new business-led NCEs, to be proposed and led by the private sector. It also committed \$4.5 million over two years to the NCE program to establish a new Industrial Research and Development (R&D) Internship program. The NCE program's ability to foster research partnerships between research institutions, government, and industry was also recognized in the government's new S&T strategy, *Mobilizing Science and Technology to Canada's Advantage*. Looking forward over the next two decades, the challenge for the NCE program will be to lever the world-class S&T research excellence and partnerships, for which it is renowned, and increasingly translate these strengths into economic and social benefits for Canadians.

To ensure the NCE program's relevance and effectiveness in helping to contribute to a better quality of life and the development of sound policy and economic growth in Canada, the NCE

Steering Committee requested that a high-level review of the program's future goals, expectations, and niche take place. This review was to be carried out by the IAC. The IAC's work will help to shape the future of the NCE program and the development of the next round of NCE competitions.

The NCE-IAC developed their recommendations as a result of extensive deliberations held during two sets of meetings and through an extensive review of background documentation. The recommendations are divided across five key categories: NCE niche; balancing and enhancing the NCE program portfolio to increase program outputs; promoting collaboration and developing partnerships within Canada and internationally; improving NCE program governance, knowledge transfer, and performance evaluation; and focusing future competitions for strategic investment. These categories reflect the NCE-IAC's deliberations with regards to the key questions the NCE Steering Committee requested they consider during their review. The recommendations are summarized below.

### NCE Niche

As the NCE program moves forward, a clear definition of the NCE's niche, especially in the context of the proposed enhancements to the program, is required. The focusing of the NCE's niche reflects a clear understanding on how the NCE program could be revitalized to bring greater values for the economic, social, and environmental development of Canada, and also reflects the increase in collaborative research initiatives being funded by the three federal granting agencies—Natural Sciences and Engineering Research Council (NSERC), Social Sciences and Humanities Research Council (SSHRC), and Canadian Institutes of Health Research (CIHR). To increase the impact and the role of the NCE program and the NCEs as

catalysts, the NCE-IAC proposes to revise the NCE mandate in such a way that the four major objectives of the program be combined in one overarching objective, putting more emphasis on the transfer of knowledge generated by the NCEs to the user sectors and including an environmental development component as part of the objective. In addition, the IAC recommends that a clear definition of the differences between the other funding mechanisms available from the granting agencies and the NCE program be an integral part of redefining its niche for the future. The Committee made the following two recommendations with regards to the NCE niche:

- **The mandate of the NCE program should be extended to include investment in national networks of centres of excellence, with the specific objective of stimulating the development and adoption of internationally competitive, leading-edge research for the economic, social, and environmental development of Canada; and**
- **To increase its impact, the NCE program should focus its resources on broader Canadian needs or problems and not be driven by discipline needs. To resolve Canadian problems, the NCE program should bring to bear all necessary expertise from the various disciplines of the granting agencies and from all relevant research institutions as appropriate. The Committee does not favor imposing “forced marriages” (e.g., to include disciplines from all three granting agencies or researchers from across the country in a network) when not needed. In addition, the IAC recommends that the NCE Steering Committee ensure that NCE networks and the NCE program investment complement existing programs of the granting agencies and the newly announced Centres of Excellence for Commercialization and Research.**

## **Balancing and Enhancing the NCE Program Portfolio to Increase Program Outputs**

Since its inception, the NCE program has focused first on delivering excellence in research through the creation of networks and collaborative partnerships, and, second, on translating new knowledge to industries and targeted sectors of the Canadian economy. As the NCE program approaches its 20th anniversary, it is fitting that the program refocus itself in an effort to build on its prior successes and to increase its emphasis on the creation of program outputs and in supporting world-class excellence in the fields of S&T research. After careful review of the existing program, the NCE-IAC made the following recommendations designed to balance and enhance the program to achieve this result:

- **The NCE program should continue to fund networks that follow the traditional model of academic-led networks. As such, these would be for focusing on emerging research areas at the boundaries of current knowledge, most likely crossing several, but not necessarily all, of the discipline areas of the three granting agencies. These networks should, however, have the needs of Canadians and their well-being as their objective. The role of these networks will be particularly important in areas that are focused on improved productivity and are likely to become supported by Canadian industry in the future.**
- **The NCE-IAC supports the federal government’s initiative to fund business-led NCEs. The Committee recommends that the NCE program support and contribute to the further development of the new business-led, needs-driven networks. These networks should reflect the S&T research priorities that will best support Canada today and in the**

future, and be aimed at increasing the R&D undertaken by the private sector in Canada. In the long-term, the NCE Steering Committee should also ensure a balance in its funding portfolio between the academic-led and business-led NCEs to nurture emerging fields of research and the creation of new companies in Canada.

- The NCE-IAC questioned whether the NCE-New Initiatives (NCE-NI) pilot program should be funded through the granting agencies rather than the NCE program. These funds could bring a greater impact by being distributed to larger and more successful NCEs. The Committee recommends that the NCE Steering Committee develop other means through the granting agencies for the support of the areas currently covered by the NCE-NIs.
- Since the introduction of the NCE-International Partnership Initiative (NCE-IPI) will aid in the expansion of the impact of current NCE network researchers and relevant stakeholders on the international scene, as well as expose international researchers to the world-class R&D that is being carried out within Canada's borders, the NCE-IAC recommends that this international dimension should be included as part of the program criteria for new networks.
- The NCE-IAC recommends developing, within the NCE program, a mechanism to address the need to educate academia about business, and to attract persons with the skills (e.g., business, research commercialization, facilitating development of public policy, ethics, and so on) to move research into commercialization and practice for both the traditional and new business-led NCEs. The addition of this element to the NCEs will strengthen the ability of the

networks to engage in knowledge translation and commercialization. The IAC thought that it was important enough to warrant the establishment of a separate NCE on management of knowledge translation, entrepreneurship, and commercialization.

- The NCE-IAC believes there is a need to concentrate resources in developing critical mass of research excellence and it strongly supports the creation of Centres of Excellence for Commercialization and Research proposed by the government in its 2007 budget. The NCE Secretariat, with its long history of networking successes, is uniquely positioned to play a key role in their implementation.

### Promoting Collaboration and Developing Partnerships Within Canada and Internationally

Encouraging partnerships that increase knowledge translation, promote commercialization, and build a cadre in Canada of world-class researchers is at the heart of the NCE program. These partnerships occur at the national level between academia, government researchers, industry, and other stakeholders within Canada, and at the international level. Continuing to promote collaboration and the development of extended networks is critical to Canada's ability to further leverage its investment in S&T research for the future. As such, the NCE-IAC makes the following recommendations to further develop this aspect of the NCE program:

- The NCE-IAC applauds the investment from the federal government to the new Industrial R&D Internships program. It encourages all networks to expand their existing internship program or use the industrial R&D internship

initiative as a model. Internships and fellowships that allow students and others to obtain business or management skills, or both, such as those required to successfully move a research discovery through to commercialization, should also be considered by all networks. This will also instill an entrepreneurial spirit in young researchers.

- The NCE-IAC proposes that the NCE Steering Committee look at mechanisms similar to those developed in Australia and Germany that will encourage government laboratories to participate fully in networks, even if they cannot be funded directly through the NCE program. One option for the government would be to create a program separate from the NCE program to provide funding for federal SBDAs, including the National Research Council (NRC), to participate in the NCE networks. Another option would be to create a funding envelope managed by the NCE Secretariat.
- Consideration should be given to the revision of the NCE program's eligible expenses and funding mechanisms to allow NCEs to fund international programs and initiatives aimed at increasing Canada's capacity and harnessing the potential partnering with international researchers to achieve outputs and outcomes that otherwise would not be possible. The NCE Steering Committee could also consider the creation of a pilot program that could lead to funding an international NCE with one or two countries on a strategic priority for Canada and the other countries.

## **NCE Program Governance, Knowledge Transfer, and Performance Evaluation**

The proposed enhancements of the NCE program require the additional support of a modified governance structure that will facilitate increased commercialization of knowledge and reflect the strategic priorities of the Government of Canada, industry, and user needs. Furthermore, in order to increase accountability and provide Canadians with concrete results, the development of improved performance indicators that are monitored throughout the networks' life cycle are required, as well as more knowledge transfer to the user community. As such, the NCE-IAC developed the following recommendations:

- The NCE program governance structure should be expanded to include members from industry as well as international representation. The NCE-IAC welcomes the federal government's decision to implement the Tri-Agency Private Sector Advisory Board to oversee the business-led NCEs and sees the potential for this board to play an advisory role for the entire NCE program (i.e., academic- and business-led NCE networks).
- The NCE-IAC felt that the NCE Steering Committee should initiate a review of the duration of the NCE funding cycle. It considers that the funding for all new NCEs should be limited to two five-year terms for a total of 10 years. In special circumstances, a third 5-year term could be funded only if the network has a viable business plan to successfully transfer the knowledge and technology to the user sector.

- All NCEs should be required to dedicate a portion of their funding—between 10 to 15 percent—of a network’s budget for knowledge and technology transfer and include this element as an integral part of their network management plan. Guidelines should be revised so that NCEs could finance up to \$100,000 to develop business plans, conduct market research, and search for venture capital suppliers or materials to enhance the ability of NCE start-ups to approach other funding sources (e.g., venture capital). In these endeavours, the Committee strongly suggests the concept of matching funds.
- The NCE Secretariat should develop a robust economic assessment model (e.g., the Cooperative Research Centres’ [CRC] model or other best practices such as those of the European Union [EU] or both) that would realistically measure the outputs and outcomes of its networks to better define its role in the national S&T framework.
- All new networks should be required to define performance indicators and a framework for their implementation at the beginning of each life cycle. These should be used to measure the success of the networks over time. Networks due for renewal in the future should also be asked to fulfill this requirement.
- The NCE Secretariat should organize a workshop with international experts on how to develop a performance framework and new measures for networks. The NCE Secretariat could also consider hiring either a specialized firm or a team of academic researchers to develop a better framework for performance evaluation.

## Focusing Future Competitions for Strategic Investment

As a national program, it is critical that the NCE program’s priorities align with the research priorities of the federal government, as well as leave space for emerging areas of research to be explored for the future. At the same time, the networks need to be balanced to reflect the needs of academia, industry, and other users. Reflecting the need to maintain a balance that focuses on priorities for today and for the future, the NCE-IAC recommends the following:

- The next NCE competition (e.g., business-led and academic-led NCEs) should be targeted to align closely with the federal government’s four strategic S&T priorities (i.e., environmental science and technologies; natural resources and energy; health and related life sciences and technologies; and information and communications technologies) as outlined in *Mobilizing Science and Technology to Canada’s Advantage*. The target areas should remain sufficiently broad to attract the best possible researchers and provide the opportunity for a range of diverse proposals to emerge.
- The NCE Secretariat, the Tri-Agency Private Sector Advisory Board, the Canadian Academies of Science, and perhaps, the newly created Science, Technology, and Innovation Council should be involved in a periodic government-led foresight exercise to identify the government and program’s long-term research priorities. The NCE-IAC also recommends that the new Tri-Agency Private Sector Advisory Board be involved in the development of guidelines for future NCE competitions.

## EXECUTIVE SUMMARY

The past 18 years have been filled with successes for the NCE program itself, the networks, and for Canadians. Not only has the NCE program helped to reshape how collaborative research is carried out in Canada and across the globe, the NCEs have also made contributions to S&T discoveries and commercialization that have improved the quality of life of Canadians. The successes of the NCEs continue to impact the everyday lives of persons both inside and outside of Canada's borders. The NCE program, as it currently exists, is a strong base from which a stronger program can be built. It is with this in mind that the NCE-IAC developed the recommendations contained herein. The goal was to provide recommendations that would enhance the program so that the NCEs can provide a greater impact in the future. The Committee members are unanimous in their support of the proposed program changes outlined in this report and all are confident that these changes would advance Canada even further as a world leader in S&T research excellence.

## BACKGROUND

The NCE program was established in 1989 as part of the Government of Canada's S&T strategy to better link research with wealth creation. The NCE program invests in national research networks that contribute research in areas critical to Canadian economic or social development. In addition to the generation of knowledge, the networks are critical to the development and retention of highly qualified research professionals that will lead Canada's S&T research in the future, and in the translation of research into novel products and technologies for commercialization and new public policies.

Today there are 19 full NCEs as well as 5 NCE-NIs bringing together researchers, industry, and not-for-profit groups from a wide range of disciplines to solve research problems focused on Canada's national priorities. The program's annual budget of \$83.4 million is leveraged by funds received from outside sources, including from private-sector companies.

Currently, the NCE program is examining its future direction to ensure relevance and effectiveness in helping to contribute to a better quality of life and the development of sound policy and economic growth in Canada. In addition to the standard five-year evaluation taking place this year, which assesses the achievements of the NCE program against its stated objectives, the NCE Steering Committee created an international advisory committee to carry out a high-level review of the program.

The NCE-IAC was appointed by the NCE Steering Committee and consists of nine accomplished international research leaders from different sectors (i.e., university, private, public, and not-for-profit) with experience in collaborative research and knowledge transfer. Selected to represent a diversity of S&T disciplines (e.g., health, social science, and natural sciences and engineering), the NCE-IAC members all have extensive and broad experience in multidisciplinary research organizations. Each has played a major role in transforming the approach used to support research, bringing research outcomes to users, and participating in foresight exercises in their prospective countries, which include Canada, Denmark, Australia, the United States (US), the United Kingdom (UK), Sweden, and Belgium (see Appendix 1 for biographies of the NCE-IAC members).

Given its mandate by the NCE Steering Committee, the NCE-IAC conducted its activities to provide advice on future strategic opportunities for the NCE program and its next competition. The tasks and deadlines of the NCE-IAC have been aligned to complement the 2007 NCE evaluation, which, in accordance with requirements of the Treasury Board of Canada Secretariat must be completed in the summer of 2007 in time to inform the submission of new program terms and conditions in the fall of 2007. Specifically, the NCE-IAC was tasked with exploring the following aspects of the NCE:

1. The NCE program's niche (i.e., current strengths, gaps, and weaknesses) vis-à-vis other similar Canadian and international programs, and how the program should evolve for its next phase (2007-12). The analysis included addressing areas such as the value added by the NCE program, strategic use of the program, areas of investment, and the scope of future NCEs.

2. The framework of the next 2008 NCE Competition (e.g., whether the competition should be targeted, areas to be addressed, whether emphasis should be placed on certain program elements such as increased level of partnerships, commercialization, and so on).

More details of the NCE-IAC framework, as well as a list of more specific questions to be addressed by the Committee, are outlined in Appendix 2.

Formal meetings of the NCE-IAC took place in Ottawa from February 7-9, 2007 and from April 29-May 1, 2007. Prior to the first meeting, the NCE Secretariat provided the NCE-IAC with an extensive collection of background documents on the NCE program, including the Blue Sky Report, which summarizes the outcomes of a one-day workshop on the future direction of the NCE program held in Ottawa in December 2006. The workshop involved approximately 125 NCE leaders, partners, and government officials who were asked to brainstorm on how to make the NCE program a more effective vehicle for addressing Canada's challenges and building upon its strengths in the short- and long-term (next five-to-ten years). Among the themes to emerge from the report were building and expanding partnerships; adopting governance structures that are flexible and inclusive; choosing priorities based on society's needs, not academic preferences; creating value from research by delivering solutions to end-users; measuring the NCE's broader impact; increasing efficiency of next generation of new networks; and instilling an entrepreneurial spirit in young researchers. The Blue Sky Report was later circulated to a wider audience of stakeholders (i.e., NCE partners from government, academia, and industry) and their comments were summarized by the NCE Secretariat for the NCE-IAC's review.

The purpose of the first IAC meeting was two-fold: to allow the members to assess the current status and niche of the NCE program, and to discuss future prospects of the program. To assist in achieving this goal, the NCE-IAC members heard presentations from several stakeholder groups, including NCE Steering Committee members, the NCE Program Director, Chairs of NCE Boards of Directors, NCE Scientific Directors, NCE Host University representatives, and senior officials from federal SBDAs. An economist from the Conference Board of Canada made a presentation on Canada's future global competitiveness as well.

During the second meeting, members of the NCE-IAC shared their own experiences in evaluating, revitalizing, or constructing programs similar to the NCE program in their respective countries. Additionally, various presentations were made from selected representatives from industry, as well as the consultant contracted to carry out the 2007 NCE Program Evaluation. Furthermore, the NCE-IAC discussed further topics related to how the NCE program could maximize the efficiency and improve the delivery of the current and new NCE programs, as well as how the NCE Secretariat could be more strategic in its approach to future competitions. Discussion was also held with the NCE Steering Committee regarding to the outcomes of the NCE-IAC review. To close the meeting, the NCE-IAC deliberated on the final recommendations. (Further details regarding the meetings, including a list of presenters and the documentation forwarded to the NCE-IAC members, are provided in Appendix 3.)

The NCE-IAC produced this report for the NCE Steering Committee as an outcome of its deliberations. It includes an analysis of the NCE program's current position and provides recommendations on its future direction.

## FINDINGS AND RECOMMENDATIONS FOR THE FUTURE

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Combining their collective experience with a scan of other national and international programs in addition to consultations with leaders in Canada's academic, government research, and private sectors, the NCE-IAC developed a series of recommendations designed to sustain the success of the NCE program and expand its reach in the future. The recommendations from the NCE-IAC mainly cover two broad topics that are related to the niche of the NCE program and how the NCE program can be more strategic in future investment.

### THE NCE NICHE

Risk taking, innovation, boldness, and, most importantly, results and impacts have become the trademarks of the NCEs. Since it was established 18 years ago, the NCE program has been hailed as an innovative model to link R&D with wealth creation. The program is based on five central features: mobilization of Canadian research excellence; training of highly skilled personnel in Canada; networking and partnerships with industry and other relevant partners; transferring the knowledge generated to the user sectors; and an effective network management structure.

The launch of the NCE program set in motion a significant cultural shift within Canada's research community. By breaking down the barriers between disciplines, institutions, and sectors, the program challenged researchers and

their partners to embrace collaboration and multidisciplinary to build a critical mass of expertise in research areas of strategic importance that will have an impact on Canadian society. The program has established itself as a major Canadian institution and is an institutional innovation emulated by countries around the world, including Germany, Japan, and France.

A testament to the NCE program's success is that multisectoral collaboration and networking has now become the mainstay of the highest levels of international research. Canada's R&D landscape has also diversified, making it timely for international experts to look at the program and provide advice to the NCE Steering Committee on its niche. This advice, based on current strengths and weaknesses, takes into consideration other similar Canadian and international programs, and how the program should evolve for its next phase (2007-12). It addresses questions such as how value can be added to the program, how it can be strategically employed, areas of investment, and the scope of future NCEs.

Overall, the NCE-IAC is impressed with the achievements of the NCEs and believes that the NCE program continues to be a leader in the support of innovation for Canada. At the same time, the program clearly has tremendous potential for enhancements. The NCE-IAC recommends that the NCE program continue to support research excellence, build on its achievements, increasingly encourage and support entrepreneurial approaches and training for highly qualified personnel (HQPs), expand partnerships into different sectors, and further evolve in areas of opportunities where it can make a significant difference. As the only

national program that supports the R&D priorities of Industry Canada and the three federal granting agencies, the NCE program occupies a unique multidisciplinary niche. The IAC therefore recommends that the NCE program continue to look for opportunities that bridge the gaps between natural science and engineering, social sciences and humanities, and health research. Furthermore, the IAC strongly recommends that the NCE program, which is considered one of the country's most important contributors to the commercialization and translation of S&T, should find more ways to act as an even stronger catalyst for translating Canadian strengths in S&T into innovation and wealth creation for Canada.

### **NCE Mandate: Catalyst for Harnessing Canadian Strengths**

With countries such as China and India increasing their S&T outputs at considerably lower costs and producing significant numbers of HQP, Canada needs to leverage its strong base of research excellence into leading-edge developments with societal, economic, and environment benefits to be globally competitive. *Advantage Canada: Building a Strong Economy for Canadians*, the federal government's long-term strategic plan, recognizes that talented, creative people are the most critical assets to a successful national economy, and commits to maintaining Canada's G8 leadership in public-sector R&D investment. It also commits to building on existing strengths, focusing efforts in key areas where Canada can achieve global excellence, and better aligning research investments with the needs of businesses to make a real impact in the market.

The plan recognizes the success of the NCE program in fostering university-led research collaboration with the private sector. It suggests building on these successes and expanding on them to maximize the impact of the government's investments in research by creating Centres of Excellence for Commercialization and Research, and business-led NCEs that will be more responsive to business needs.

Turning scientific breakthroughs into profitable solutions is a challenge in every country. Canada's productivity gap relative to the US is widening and lags behind many Organisation for Economic Co-operation and Development (OECD) countries in translating research strength into innovation gains. The Committee heard presentations about several international initiatives, including Texas' Emerging Technology Fund, the Swedish Centres of Excellence, Denmark's National Advanced Technology Foundation, the Swiss Innovation Promotion Agency, the Commonwealth Scientific and Industrial Research Organisation's (CSIRO) National Research Flagships program (Australia), and the EU Framework program, which support the implementation of new knowledge from the laboratory into innovative products. Many of these programs are strategically aligned with their prospective government's priorities, such as environment, climate change impacts, new energy, security, information technology, and health sciences.

By focusing the NCE program's mandate to needs-driven research, the program will be in an excellent position to assist the Canadian government in mobilizing research to meet the changing needs of our society and economy. The NCE-IAC also recommends that the NCE

program make a solid commitment to developing solutions that have environmental benefits, such as new energy technologies. As well as being a federal government priority, this was identified in *The State of Science and Technology in Canada* (published by the Council of Canadian Academies in 2006) as an area where Canada is well positioned to develop prominent strength. In addition, the program should contribute to strengthening Canada's research base through the training of new researchers in a multidisciplinary and multisectoral setting—especially in areas of interest to NSERC, SSHRC, CIHR, and Industry Canada—as well as attract and retain experienced researchers.

To increase the impact and the role of the NCE program and the NCEs as catalysts, the NCE-IAC proposes to revise the NCE mandate so that the four major objectives of the program are combined in one overarching objective, thereby putting more emphasis on the transfer of knowledge generated by the NCEs to the user sectors and including an environmental development component.

### **Recommendation 1**

The mandate of the NCE program should be extended to include investment in national networks of centres of excellence, with the specific objective of stimulating the development and adoption of internationally competitive, leading-edge research for the economic, social, and environmental development of Canada.

### **Supporting the NCE Program's Federal Partners**

The three granting agencies and Industry Canada are the NCE program's partners. The NCE-IAC spent significant time discussing the future direction of the NCE program with the presidents of CIHR, NSERC, and SSHRC, and Industry Canada representatives. The presidents of the three federal granting agencies and the Deputy Minister of Industry Canada are members of the NCE Steering Committee, which is chaired by the President of NSERC; they have overall authority for the management of the NCE program. The Steering Committee exercises executive authority, makes policy decisions within the framework of the objectives and design of the NCE program, and reports to the Minister of Industry Canada annually. The day-to-day administration of the NCE program is provided by the NCE Secretariat, which is housed by NSERC and made up of staff from the three granting agencies.

Since the NCE program was created, the R&D landscape has changed in Canada quite significantly; for example, the CIHR Institutes, NSERC's Strategic Network Grants, and SSHRC's Major Collaborative Research Initiatives, and the NSERC Industrial Research Chairs program have all been created. Although these programs were created to achieve different objectives, all have incorporated elements of the NCE program. For example, since 2000, CIHR's Institutes coordinate and plan health research agendas that address specific health areas, health concerns of specific populations and health services research. The Institutes, which are permanent in nature, receive about \$8 million per year to bring together stakeholders such as representatives of public-interest groups, health

practitioners, other users of health-research findings, government officials, and researchers, and for planning and implementing initial strategic initiatives (e.g., capacity development).

NSERC's strategic networks are similar in nature to NCEs, though their research objectives are more short-term oriented with funding for only five years. The networks do not have to be national; they usually involve fewer participants than a full NCE and are now confined to NSERC's strategic priority areas (mainly in natural sciences and engineering). While a few of the existing NSERC research networks have social science, humanities, or health components that are funded by other partners, NSERC only funds NSERC-related research. Over the last several years, SSHRC has also invested in new collaborative programs and partnerships that address complex research questions on important social issues such as the Major Collaborative Research Initiatives (MCRI), which provide support to large-scale, leading-edge research that addresses broad and critical issues of intellectual, economic, and cultural significance, and an Initiative on the New Economy (INE), which helps Canada and Canadians adapt successfully to and benefit from the new economy. The above programs provide funds to large-scale Collaborative Research Initiatives for multi-university, multidisciplinary teams to address complex research questions relevant to Canada.

The NCE-IAC strongly recommends to the NCE Steering Committee that the granting agencies work together to ensure complementarity and synergy among all of its programs, including the NCEs, and to develop a strategic approach for continued collaboration. The NCE-IAC considered that, compared to other granting agencies' programs, the NCE program has a stronger focus on outcomes that increase the

well-being of Canadians and on Canadian productivity in all economic sectors. Through the leadership of the NCE Steering Committee and the NCE Secretariat, it is essential for Canada and Canadians that projects supported by the NCE program meet the overall goals of the granting agencies on the one hand and, on the other, that of the NCE program.

The NCE-IAC felt that as an instrument of both the granting agencies and the federal government, the NCE program is in a unique position to fund S&T initiatives that are at the boundaries of the research domains of the individual agencies. The NCE program needs to continue to fund research based on issues that are of critical importance to the country and bring together the talent and skill set from the different disciplines to address complex issues. This would also allow the program to provide multidisciplinary training to the next generation of researchers in complex environments they may not otherwise be exposed to. It also represents a forum in which to incubate talent in the social sciences and humanities communities that have, until recently, played a limited role in the NCE program. As the NCE-IAC discussed, multidisciplinary would not be a mandated requirement for the program (no "forced marriages"). The IAC believes that the program should continue to support research excellence, building on its achievements and entrepreneurial approach, and should evolve in areas of opportunities where it can make a significant difference. This has led to the second recommendation:

## Recommendation 2

The NCE-IAC recommends that to increase its impact, the NCE program focus its resources on broader Canadian needs or problems and not be driven by discipline needs. To resolve Canadian problems, the NCE program should bring to bear all necessary expertise from the various disciplines of the granting agencies and all relevant research institutions, as appropriate. The Committee does not favor imposing “forced marriages” (e.g., to include disciplines from all three granting agencies or researchers from across the country in a network) when not needed. In addition, the IAC recommends that the NCE Steering Committee ensure that NCE networks and the NCE program investment complement existing programs of the granting agencies and the newly announced Centres of Excellence for Commercialization and Research.

## BALANCING AND ENHANCING THE NCE PROGRAM PORTFOLIO TO INCREASE PROGRAM OUTPUTS

A key element of the Government of Canada’s Innovation Agenda, the NCE program builds on the foundation of research support from the federal granting agencies and on the long tradition of excellence that exists at Canadian universities. The program invests in university-based networks that conduct research and technology development in areas of strategic importance and applies it to the advancement of Canada’s economy and society.

Each network builds partnerships between academia, industry, and government to put new knowledge, research, and technology to work to create a better Canada. HQPs—from graduate students and post-doctoral fellows to world leaders in their particular fields, including Canada Research Chairs—work co-operatively through NCE-sponsored initiatives in disciplines covered by the three granting agencies.

### *Traditional NCEs*

The NCE Steering Committee asked the NCE-IAC to review the NCE model and determine whether the current balance within the NCE program portfolio accurately reflects Canada’s changing R&D needs. Based on the Committee’s discussions and review of background documents, the NCE-IAC felt that there is no question about the success of the traditionally funded NCEs. In the last seven-year cycle (1998–2005) alone, NCE scientists were issued more than 300 patents with approximately 27,000 papers published in refereed scientific journals. More than 500 licences were granted or are being negotiated,

while 70 new Canadian companies owe their existence to NCE-supported research. NCE researchers continue to be at the leading edge of international research communities in their areas of expertise. As such, they continue to raise the profile of Canadian S&T and the research community on the world stage.

The NCE-IAC endorses the fact that academic-led NCEs should be pursued in emerging areas of research that will be important for Canada in the context of the global knowledge economy. As such, the Committee makes the following recommendation:

### **Recommendation 3**

The NCE program should continue to fund networks that follow the traditional model of academic-led networks. As such, these would be for focusing on emerging research areas at the boundaries of current knowledge, most likely crossing several, but not necessarily all, of the discipline areas of the three granting agencies. These networks should, however, have the needs of Canadians and their well-being as their objective. The role of these networks will be particularly important in areas that are focused on improved productivity and are likely to become supported by Canadian industry in the future.

### *Building Business-led NCEs*

While Canadian businesses have and continue to play a critical role in the success of the NCE networks, the current structure of the NCE program has not championed business-led networks. The NCE-IAC embraces the federal government's decision to create up to five new business-led NCEs, which will be managed by the NCE Secretariat. These networks would be needs-driven, either responding to the Government of Canada's strategic research priorities or through a bottom-up approach where industry, working with the researchers, identifies critical problems to be addressed. Such programs seek synergy and the understanding of academics and industry toward the amplification of value to Canada. There is also a requirement to balance the needs of Canadian industry as it exists today and the predicted future needs of Canada's industrial structure.

As this initiative moves forward, the NCE-IAC recommends that it will be important to balance support between traditional academic-led and business-led NCEs. This should include looking at areas of emerging Canadian research strengths, as well as focusing on creating a program that addresses business needs while remaining flexible enough to nurture university needs.

The Committee fully supports any efforts to increase Canada's S&T commercialization activities, and as a result, makes the following recommendation:

**Recommendation 4**

The NCE-IAC supports the federal government's initiative to fund business-led NCEs. The Committee recommends that the NCE program support and contribute to the further development of the new business-led, needs-driven networks. These networks should reflect the S&T research priorities that will best support Canada today and in the future, and be aimed at increasing the R&D undertaken by the private sector in Canada. In the long-term, the NCE Steering Committee should also ensure a balance in its funding portfolio between the academic-led and business-led NCEs to nurture emerging fields of research and the creation of new companies in Canada.

**Pilot Programs in the NCE Program Portfolio**

The current NCE program portfolio is made up of the traditional NCEs, which compose the bulk of the program, as well as five NCE-NIs, which were introduced in 2005. In contrast to the traditional NCEs, the NCE-NIs do not receive money to fund research; rather, the funds provided are designated for the support of the creation of networking opportunities among well-established researchers and research teams. One of the aims of the NCE-NIs is to increase networks led by researchers in the social sciences community. A second pilot project, the NCE-IPI, was launched in 2006 with the goal to provide

the NCEs with additional support to develop and enhance linkages with equivalent organizations in the rest of the world. Both have the requirement of improving productivity for public benefit (i.e., milestone objectives and thus ease of accountability).

As noted, the NCE networks' success over the last 18 years has resulted in a dramatic shift in the way researchers are funded, including increases to funding programs at the individual granting-agency level to initiate networking activities. While the Committee was impressed with the presentations made by NCE-NI recipients, there was concern that this new program may be spreading the NCE program portfolio too thinly.

Based on these deliberations, the NCE-IAC made the following recommendation:

**Recommendation 5**

The NCE-IAC questioned whether the NCE-NI pilot program should be funded through the granting agencies rather than the NCE program. These funds could bring a greater impact by being distributed to larger and more successful NCEs. The Committee recommends that the NCE Steering Committee develop other means through the granting agencies for the support of the areas currently covered by the NCE-NIs.

In contrast, the NCE-IPI pilot program is an addition to the current full NCEs' funding and represents funding that is not available elsewhere. The Committee felt that the NCE-IPI program was a very favourable element, and

that international collaboration should be incorporated into all NCEs to bridge Canadian and international knowledge that will benefit Canada in the short- and long-term. This is reflected in the Committee's sixth recommendation, outlined below.

### **Recommendation 6**

Since the introduction of the NCE-IPI will aid in the expansion of the impact of current NCE network researchers and relevant stakeholders on the international scene, as well as expose international researchers to the world-class research and development that is being carried out within Canada's borders, the NCE-IAC recommends that this international dimension be included as part of the program criteria for new networks.

### **Improving Support for Commercialization**

A key output of the NCE program is the translation of R&D to products or services ready for commercialization. The inexperience of academic-based researchers in performing knowledge transfer and commercialization functions was cited as a reason that more of these activities are not currently taking place, not only in Canada but worldwide. Any increase in this area requires a new approach to supporting industry and academia in taking on these tasks.

This challenge is two-fold: firstly, instilling the necessary entrepreneurial skills and mindset in researchers so that they actively seek out

commercialization opportunities; and secondly, funding start-up companies during the period when they are not yet viable targets for venture capital financing.

This may be best addressed by increasing the involvement of business schools in the NCEs, perhaps through the creation of a network consisting primarily of business schools with the specific focus of assisting NCEs with entrepreneurship and knowledge transfer. An initiative out of Rice University in Houston, Texas, the Rice Alliance for Technology and Entrepreneurship, has shown just how lucrative such an endeavour can be. Devoted to the support of technology entrepreneurship, the Rice Alliance has assisted in the launch of over 170 new technology companies; Rice Alliance companies have raised more than US \$300 million for early-stage funding since its inception in late 1999. This model of technology entrepreneurship is now accepted in many businesses. Requiring that every network have business experts, such as finance experts, on their boards, which has proven successful in a variety of research programs in Denmark, Texas, the UK, and Sweden, is an option recommended by the NCE-IAC.

Alternately, NCE could consider funding a knowledge-transfer, or knowledge-application network that is focused on identifying the projects with the most potential for commercialization from those of all the current networks. The involvement of business schools is key to the success of either choice.

This need to produce more researchers who are also skilled in business and management, and as such, better positioned to commercialize S&T research, is reflected in the NCE-IAC's seventh recommendation.

**Recommendation 7**

The NCE-IAC recommends developing, within the NCE program, a mechanism to address the need to educate academia about business, and to attract persons with the skills (e.g., business, research commercialization, facilitating development of public policy, ethics, and so on) to move research into commercialization and practice for both the traditional and new business-led NCEs. The addition of this element to the NCEs will strengthen the ability of the networks to engage in knowledge translation and commercialization. The IAC thought that it was important enough to warrant the establishment of a separate NCE on management of knowledge translation, entrepreneurship, and commercialization.

research centres and promising groups of researchers where further funding will dramatically increase their ability to compete on the international stage. The competition for clusters has mobilized universities to integrate the concept of commercialization into institutional strategic and thematic planning and to reflect their long-term priorities. It has also helped to increase the attraction of the different countries as research locations in the long term and to improve their international competitiveness. In order to assist in the creation of the required critical mass in Canadian S&T research, the NCE-IAC makes the following recommendation:

**Recommendation 8**

The NCE-IAC believes there is a need to concentrate resources in developing a critical mass of research excellence, and it strongly supports the creation of Centres of Excellence for Commercialization and Research proposed by the government in its 2007 budget. The NCE Secretariat, with its long history of networking successes, is uniquely positioned to play a key role in their implementation.

**Centres of Excellence for Commercialization and Research**

The NCE-IAC supports the government's mandate to build Centres of Excellence for Commercialization and Research, believing that they are essential to economic development in Canada and that they will strengthen the international competitiveness and effectiveness of Canadian research. This will likely have a significant impact on the quality of the overall NCE program. The Committee heard presentations about the development of such programs in Germany, Sweden, Australia, and Denmark. In each case, the clusters have resulted in the identification of internationally strong

**PROMOTING COLLABORATION AND DEVELOPING PARTNERSHIPS WITHIN CANADA AND INTERNATIONALLY**

The NCE-IAC noted that the NCE program’s added value lies in the diversity of talent and knowledge that it can bring together to solve problems of national importance. Every effort should be made to expand these partnerships across all sectors, as well as beyond the borders of Canada. The creation of business-led NCEs may help to facilitate more industry interest and support for the NCE program and result in increased development and transfer of technology and commercialization. Equally important is the fact that these networks will encourage connectivity and make the knowledge and talent being produced through public R&D more accessible to industry in Canada.

To increase success, the NCE-IAC felt that NCEs need to expand their knowledge base to attract the world’s best talent. This requires increased collaboration with industrial, non-governmental organizations (NGOs), international researchers, provincial and federal government researchers (including researchers from the NRC), and international network-like organizations.

The NCE-IAC was convinced that increasing industry and other relevant stakeholder’s engagement at the application stage and early on in the process for the academic-led NCE networks is also essential. The focus of this collaboration may not involve fundamental research of a traditional kind, but rather the translation of new knowledge to particular applications, as well as additional industrial applications.

**Fostering New Research Talent and Bridging the Gap Between Academia and Industry**

Building a better future for Canada—one in which its economy grows stronger, its people become healthier, and their quality of life improves—means making sure that today’s young, gifted people are given every opportunity to gain the skills and experience they will need to become tomorrow’s leaders in their chosen fields. As part of the overarching goal to mobilize excellence, each NCE network looks for ways to encourage its HQPs and trainees to transform their bright ideas into economic and social benefits. Many of the networks include learning and networking opportunities for students as part of their range of activities. To date, the NCEs have engaged more than 7,000 researchers and HQPs (e.g., research associates and technicians, university professors, post-doctoral fellows, and graduate students) and approximately 84 percent of network graduates are successful at finding employment upon graduation.

From the NCE-IAC’s perspective, however, there is room for improvement. Canada, as a whole, has fewer highly qualified S&T students and workers than many other OECD countries. This may be the result of a low demand for these skills in the private sector; many Canadian companies do not consider R&D to be part of the necessary strategy for national or global competitiveness (e.g., some Canadian companies are off-shoring their R&D to other countries). The NCE program can play an even greater role in engaging Canadian companies—large and small—to participate in Canadian-based R&D. Industrial R&D internships, like those occurring in the Mathematics of Information Technology

and Complex Systems (MITACS) network, which places students in an industry setting to help them solve a problem, are a premier example of how industry and academia can work together. In addition to exposing students to the private sector and the prospect of working in industry rather than academia, the internships also increase the amount of research performed by Canadian companies. Often, the value of in-house research capacity is quickly recognized by industry and many student researchers go on to work with the company where they completed their internship. The success of the industrial internship program highlights the usefulness of such programs to help persons from various fields and sectors attain skills in an area outside their usual realm. The NCE-IAC recognizes the positive impact on knowledge translation and commercialization that would result by funding students to work within industry. The Committee was pleased that the federal government clearly endorsed the industrial R&D research internships in the last budget, providing \$4.5 million over two years to the NCE program for this program.

The Committee further suggested an expansion of the internship program. For example, a fellowship might be designed to allow a physics student to gain marketing or business management experience. The concept, which would require more exploration, would promote multidisciplinary among researchers, and educate them about the bigger picture—markets versus a specific technology—and should ultimately lead to more translation. Ideally, this program would be expanded to not only include students, but researchers involved throughout the various sectors represented within the NCEs (including government and non-government labs, and industrial members), as well as those at an international level.

The goal to produce more HQPs that can help lead Canada's S&T research in the future through internships and other mechanisms is reflected in the Committee's ninth recommendation.

### **Recommendation 9**

The NCE-IAC applauds the investment from the federal government to the new Industrial R&D Internships program. It encourages all networks to expand their existing internship program or use the industrial R&D internship initiative as a model. Internships and fellowships that allow students and others to obtain business or management skills, or both, such as those required to successfully move a research discovery through to commercialization, should also be considered by all networks. This will also instill an entrepreneurial spirit in young researchers.

### **Promoting Increased Collaboration with Canadian Government Researchers**

Increasing collaboration with federal SBDAs, NRC researchers, and provincial organizations could also help the NCE program exploit the potential synergies inherent in Canada's research capacity. Currently, government researchers can participate in networks but are unable to receive any direct financial support through the program.

The inability to fully engage the researchers in networks is a significant loss not only to the networks themselves, but to Canada's ability to find innovative solutions to the problems that the country currently faces. Bringing these researchers into the networks' fold would benefit both the networks and the government departments and agencies to which the researchers belong, adding value to the research dollars spent by Canadian governments at all levels. This is especially relevant at a point in time when there is a high demand for science-based policy development in a variety of SBDAs (e.g., the need to develop research-based policy aimed at mitigating the effects of climate change).

The NCE-IAC was informed that encouraging collaboration between publicly funded research agencies (PFRAs) and universities is a key principle of Australian research and innovation policy, and that a collaborative environment is seen as one of Australia's comparative advantages. In particular, the Australian Cooperative Research Centres (CRC) program was specifically designed to engage the whole of the Australian research community and can therefore fund all parties. Of the 72 currently operating CRCs, 49 involve CSIRO, the Australian equivalent of the NRC. Similarly, the recently announced National Collaborative Research Infrastructure Strategy (NCRIS), which is providing \$542 million over 2005–11 to Australian researchers with major research facilities, supporting infrastructure, and networks necessary for world-class research, does not differentiate between the PFRA and university sectors. The Australian government's 2004 *Review of Closer Collaboration between Universities and Major Publicly Funded Research Agencies* noted that, while there are significant differences in the expectations and motivations of the university sector and the government's research agencies, the Australian experience

shows the benefits, particularly in a small economy, of overcoming these cultural and administrative barriers.

Similar models were also discussed by the IAC including the Helmholtz Association of German Research Centres. These institutions were permitted by the German government to compete for funds with universities. They have also been permitted by government to use 20 percent of their funds, not for the targeted research that they are supposed to do for the government, but for investigator-initiated research. Ever since, their competitive situation has improved dramatically.

The NCE-IAC recognizes the necessary constraints that exist within the administration of government funding as set out by Acts of Parliament and Treasury Board guidelines. As such, there is an acknowledgement that the funding for the participation of SBDAs may not be best provided through the NCE program. However, the Committee stresses that there is a vital need for the federal government to provide a funding mechanism that will allow the SBDAs to participate more fully in the networks established through the NCE program. As such, the Committee makes the following recommendation:

**Recommendation 10**

The NCE-IAC proposes that the NCE Steering Committee look at mechanisms similar to those developed in Australia and Germany that will encourage government laboratories to participate fully in networks, even if they cannot be funded directly through the NCE program. One option for the government would be to create a program separate from the NCE program to provide funding for federal SBDA's, including the NRC, to participate in the NCE networks. Another option would be to create a funding envelope managed by the NCE Secretariat.

is required. Direct involvement of non-Canadian researchers in NCE networks would allow the networks to expand their reach outside of Canada and leverage their investment into world-class successes. Such funding would also facilitate establishing partnerships between existing Canadian networks and like-minded networks around the world, and the development of new binational research initiatives such as those being established by countries such as the US, Germany, Denmark, Sweden, and Australia. The Australian Research Council, for example, is collaborating with the National Science Foundation in the US on a Materials World Network. Given the similarities between Australia and Canada, in terms of demographics and research priorities and strengths, there are numerous potential areas of research for an international NCE initiative (e.g., agriculture, animal/infection diseases, sustainable energy production, resources, climate change).

**Supporting International Co-operation**

The importance of international co-operation in the changing global S&T climate cannot be overestimated. Several of the current NCEs have some level of international involvement; however, it is critical that all networks have a more international outlook and that international funding be part of the network structure.

The NCE's IPI, which has a budget of \$7 million over two years to provide the NCEs with additional support to develop and enhance linkages with equivalent organizations in the rest of the world, is a positive vehicle to facilitate global collaboration. These funds are an add-on to the existing funding a network receives.

While the NCE-IPI represents a key initial investment, additional long-term funding to promote international involvement in the NCEs

A good example for joint international programs is Germany's Deutsche Forschungsgemeinschaft (DFG) international research training groups. These are funding instruments in which a small group of professors in two countries (e.g., Germany and Finland) together with their graduate students form a consortium that is funded by their respective national organizations using a joint peer-review. This could be used by NCEs to develop and encourage the development of specific expertise needed in Canada.

The traditional boundaries for international collaboration have also expanded. The Australian government is exploring how to expand S&T funding to include collaborations between Asian and Australian researchers; the UK is working with South African researchers; and Germany is working closely with Korea,

China, India, and Japan among others. An increased international presence along these lines is key to Canada developing deeper relationships with researchers in countries in Asia and Africa, which represent a key future market for S&T commercialization. International programs such as the Danish National Research Foundation program permit the use of program funds to cover the research costs of foreign researchers when this is essential to achieve the goal of the project. The Collaboration Fund of CSIRO's National Research Flagship program has also been recently expanded to allow international partners to be funded (including research costs) where that expenditure is essential to deliver the Flagship goals.

The NCE-IAC considers that the principal advantage for international collaboration is to increase Canada's capacity to successfully pursue research that leads to the transfer of knowledge to new public policy, practices, and technology development and commercialization. In addition, international partnerships are an effective method for showcasing Canada's talent and research opportunities to help attract established, world-class researchers to Canada to help build S&T research capacity to a critical mass. Revisions to funding mechanisms to achieve this goal are reflected in the following recommendation:

### **Recommendation 11**

Consideration should be given to the revision of the NCE program's eligible expenses and funding mechanisms to allow NCEs to fund international programs and initiatives aimed at increasing Canada's capacity and harnessing the potential partnering with international researchers to achieve outputs and outcomes that otherwise would not be possible. The NCE Steering Committee could also consider the creation of a pilot program that could lead to funding an international NCE with one or two countries on a strategic priority for Canada and the other countries.

## NCE PROGRAM GOVERNANCE, KNOWLEDGE TRANSFER, AND PERFORMANCE EVALUATION

### Governance

The governance of the NCE program is currently shared between two bodies: the NCE Steering Committee, composed of the presidents of the three granting agencies and the Deputy Minister of Industry Canada; and the NCE Management Committee, composed of a representative at the vice-president level from each of the three granting councils and Industry Canada, the NSERC Director of Policy and International Relations, and the Director of the NCE program itself.

There is no doubt that the leadership and vision of these two committees has been instrumental in the NCE program achieving the successes it has over the past 18 years. However, the NCE-IAC notes that the structure could be enhanced to better reflect the evolving nature of the program. One of the primary concerns is that in order to achieve better balance, the governance structure should include members from outside government, such as industry. Looking internationally, the NCE-IAC was impressed by the diversity of representation on the boards of many similar organizations, including the Danish Advanced Technology Foundation, a “government-initiated” program that funds basic and applied research in partnerships with industry. This nine-member board, like Denmark’s other national S&T programs, contains representatives from industry, academia, and government research. The NCE-IAC strongly supports a move in this direction for the governance of the NCE program.

As such, the NCE-IAC welcomed the federal government’s decision to implement the Tri-Agency Private Sector Advisory Board to oversee the business-led NCEs and sees the potential for this board to play an advisory role for the entire NCE program. This evolution in program management will allow increased input from industry as to what industry’s needs are, and allow for benchmarking against international standards. In conjunction with the national research policies set out in *Mobilizing Science and Technology to Canada’s Advantage*, the recently released federal government S&T strategy, this evolution will greatly assist in the selection of new networks for funding to help formulate solutions to the challenges that will shape the future of Canada.

Furthermore, as the NCE program expands beyond Canada’s borders, it is critical that there be international representation, comprising persons who have managed similar major business programs, on the Tri-Agency Private Sector Advisory Board. The NCE Steering Committee’s decision to consult with an international advisory committee in the review of the NCE program was a very forward-looking decision and is an option that should be employed again in the future.

As the program is enhanced to achieve greater impacts, the Committee feels that it is important that the governance structure also be enhanced. This belief is reflected in the following recommendation:

### Recommendation 12

The NCE program governance structure should be expanded to include members from industry as well as international representation. The NCE-IAC welcomes the federal government's decision to implement the Tri-Agency Private Sector Advisory Board to oversee the business-led NCEs and sees the potential for this board to play an advisory role for the entire NCE program (i.e., academic- and business-led NCE networks).

### Modifying Funding Cycles to Promote Knowledge Transfer

Under the current NCE program, "traditional" networks are eligible to receive an initial seven years of funding and, if successful during the review of their renewal application, to receive an additional seven years of funding. Therefore, each network is eligible to receive a lifetime total of 14 years of funding through the NCE program with a possibility of two more years of limited funding support to finalize their activities through the research management funds (i.e., up to \$500,000 over two years). After this time, the networks must secure alternative sources of funding in order to continue to operate. As recently announced by the federal government, this model is being modified for the business-led networks. Business-led networks will be funded for a five-year funding term. This raised the question of whether or not the traditional NCEs should be limited to 2 five-year terms, rather than 14 years of funding.

The Committee discussed the life cycles of numerous international programs and heard from a variety of network representatives. There were strong arguments on both sides of the debate. Clearly, initiatives geared at emerging fields of research or "discovery" research can take longer to produce outputs, while programs focused on exploiting research with obvious commercial potential are short-term (e.g., the Swiss Confederation's innovation promotion agency, CTI, and Denmark's Advanced Technology Foundation). However, there is also evidence, provided by network representatives, indicating that under the current funding cycle the final years of a network's life cycle are not being used as effectively as they could be and that sometimes it is difficult to sustain partners' interests in the network. Self-sustainability is not a requirement for the NCE program. Even though some networks would like to become self-sustainable, the Committee recognizes how difficult it could be for a network or similar organizations to become self-sustainable. It felt that even though a network might not be self-sustainable, the outcomes of the network should remain sustainable.

Instead of focusing on producing outputs and outcomes, networks often rush to find additional funding and opportunities for sustainability and knowledge transfer near the close of the network's existence under the NCE program. This greatly limits the networks' ability to effectively carry out their main tasks. Additional comments indicated that during this period it is difficult to develop new industrial links or stabilize existing ones, as the network will soon cease to exist. It is clear that the two issues are intertwined in the debate, the first being the optimal funding period, and the second being the timing of when the networks begin to engage in knowledge transfer activities. Requiring

networks to engage in more intense knowledge transfer activities from network inception through to termination would remove the sudden change of focus currently happening near the end of a network's mandate (see Funding to Support Knowledge and Technology Transfer, below).

The Committee's review of the funding models currently used in similar programs internationally revealed several variations in approach. For example, Australia's CRC program provides funding for an average of two seven-year terms; the UK's Economic and Social Research Council Centres program funding is set up for two five-year periods with the possible extension of another term, provided the centres have developed a robust business plan demonstrating how they will continue when funding ceases. However, the consensus of the Committee was that reducing the term that funding is available would promote the engagement of networks in business planning and goal setting earlier in their life cycle. In addition, since the program has limited resources, a shorter funding cycle will stimulate the creation of new NCEs. As such, the NCE program should adopt the following recommendation:

### **Recommendation 13**

The NCE-IAC felt that the NCE Steering Committee should initiate a review of the duration of the NCE funding cycle. It considers that the funding for all new NCEs should be limited to two five-year terms for a total of 10 years. In special circumstances, a third 5-year term could be funded only if the network has a viable business plan to successfully transfer the knowledge and technology to the user sector.

## **Funding to Support Knowledge and Technology Transfer**

While the NCE program has been responsible for more than 70 spin-off companies since 1998, with several of these meeting with great success, the NCE-IAC identified a clear need to provide networks with a greater ability to fund start-ups using NCE program funding and increase support to knowledge transfer. This would better support the use and commercialization of S&T generated through network activities. Additionally, several networks commented that the limitations placed on the current funding, in terms of not being able to fund spin-off or start-up companies, also decreased their ability to develop products or services for commercialization, critical outputs for the NCEs. To this end, the NCE-IAC looked again to other like-minded organizations for guidance. One of the most successful examples that the Committee reviewed was the Texas Emerging Technology Fund, which sets aside 20 percent of its initial funding for start-up companies. While it is unlikely that all networks will lead to new companies, it is critical that commercialization is strongly encouraged from the project's inception. Linking seed funds or venture capital funds to these promising discoveries expands the Canadian science value growth.

The following recommendation, if accepted, would provide networks with the required assistance in support of commercialization activities. Also linking this recommendation to recommendation 7 (educating academia about business and attracting persons with the skills to move research into commercialization and practice) will provide a successful business plan to match the scientific discoveries.

**Recommendation 14**

All NCEs should be required to dedicate a portion of their funding—between 10 to 15 percent—of a network’s budget for knowledge and technology transfer and include this element as an integral part of their network management plan. Guidelines should be revised so that NCEs could finance up to \$100,000 to develop business plans, conduct market research, and search for venture capital suppliers or materials to enhance the ability of NCE start-ups to approach other funding sources (e.g., venture capital). In these endeavours, the Committee strongly suggests the concept of matching funds.

**Developing Network-specific Performance Indicators**

While the current outcome indicators collected by the NCE program and described in the Results-based Management and Accountability Framework (RMAF) are valuable tools in tracking specific aspects of network performance, the NCE-IAC notes that they do not adequately capture the broader economic value of the NCE program’s outcomes, nor do they effectively measure the added value generated in terms of social and health outcomes.

During the Blue Sky discussions, it was noted by participants that bibliometric indicators do not provide a complete picture of the effectiveness of a multidisciplinary and partner-focused program. Furthermore, participants recommended using international benchmarks, the sustainability of relationships established through networks after funding expires,

implementation of new methodologies for measuring social capital resulting from network activities, and early development and tracking of performance indicators. Members of the NCE Steering Committee also recommended changes to performance indicators, particularly as they pertain to health and social sciences. They cited several NCEs that help to improve Canada’s productivity through improving best practices, streamlining health-system efficiencies, and focusing on the social fabric of the country—benefits that cannot be measured in traditional economic impact terms.

These challenges are not unique to the NCE program; they are reflected in similar programs in other countries. Australia’s CRC program has attempted to overcome this challenge by quantifying how economic outcomes in the country would have been different in the absence of the program and its activities. Like the NCE program, the CRC program has played a pioneering role in bringing together public- and private-sector researchers and research end-users to focus on solving real challenges of importance to the country by encouraging medium- to long-term-oriented collaboration between research providers and research users. In addition to readily quantifiable performance areas, such as commercialization performance and student training, the program plays a role in the generation of new knowledge that is then applied by end-users, and in engendering cultural change in the way that public-sector researchers and private-sector research end-users interact.

To determine how the CRC program has contributed to the overall productivity of the country, an economic assessment was done using four levels of impact modelling. These levels included establishing a lower limit estimate of delivered CRC program benefits and attributed delivered impacts, and a realistic

estimate of delivered and forthcoming non-contingent CRC program benefits and contingent benefits. When the assessment was completed, the net impact of the CRC program was quantified in terms of gross domestic product, total consumption and its component parts, private and public consumption, and investment.

Following an economic assessment model, such as the CRC's, will not only increase accountability, it will provide tangible evidence of the NCE program's importance on a national scale. It would also facilitate a better reporting mechanism for the independent evaluations required by the Treasury Board every five years, which are currently based largely on anecdotal information such as case studies, surveys, and interviews.

The Committee believes that the CRC's economic assessment model is a good fit for obtaining a realistic measurement of outputs and outcomes, and thus makes the following recommendation:

### **Recommendation 15**

The NCE Secretariat should develop a robust economic assessment model (e.g., the CRC model or other best practices such as those of the EU, or both) that would realistically measure the outputs and outcomes of its networks to better define its role in the national S&T framework.

### **Setting Performance Indicators Early and Increasing Accountability**

NCE networks should develop performance indicators early on that reflect the specific needs of their respective disciplines. For example, the

impacts of the social science-focused network will need to be measured in terms that are vastly different than measuring the impact of the introduction of a new technology output. As such, it may be unrealistic to achieve multifaceted, all-encompassing performance indicators that are uniformly applied across the various NCEs. These performance indicators need to be developed as part of the application stage and monitored by each network board from the inception of the networks and continue to be adjusted, as needed, and monitored throughout each network's life cycle.

CSIRO's Flagships program outcome reporting structure provides an excellent model for the NCE program with its diversity of networks. Each Flagship is required to identify research and engagement milestones from the project's onset. These milestones are then annually assessed on the basis of four broad categories of outputs:

- New or improved technology or management system;
- Advice or "catalyst services" for policy or business;
- New or improved intermediate or final products; and
- New knowledge or skills.

Nine different types of impacts that result from the application or use of these outputs are also considered. These outcomes are directly aligned with Australia's national research priorities (NRPs). For example, with the Healthy Environment and Lifestyles (one of Australia's NRPs), the application or use of a Flagship's outputs could be measured on how it contribute improved human health, safety, and well-being, pollution reduction, and improved environmental health.

Following this model, a network that fails to engage end-users or sets the barriers for success too high (based on the reporting of such performance indicators) would be discontinued. Conversely those networks that are successful and grow in size and complexity would be eligible for supplemental funding. As such, the Committee made the following recommendation:

### **Recommendation 16**

All new networks should be required to define performance indicators and a framework for their implementation at the beginning of each life cycle. These should be used to measure the success of the networks over time. Networks due for renewal in the future should also be asked to fulfill this requirement.

### **Assisting NCE Networks in Developing Required Performance Indicators**

As noted earlier, requiring networks to set performance indicators early on will be extremely beneficial, if not essential, to the NCE program's long-term success. However, the NCE Secretariat should provide the networks with support and guidance in the development of these performance indicators.

The NCE-IAC discussed various possible options as to what form this assistance may take. The Economic and Social Research Council in the UK, for example, has worked with the Centre for Science and Technology Studies, a bibliometric group in Leiden University, the Australian National University, and researchers at Georgia Institute of Technology on developing bibliometric indicators with regard to social

sciences. Other suggestions on how to accomplish this included organizing a workshop with international experts in developing performance frameworks and measures to discuss the indicators available to make such an analysis.

Because of the diversity and complexity of success indicators across the networks, the Committee strongly recommends seeking outside support, such as hiring a specialized firm to analyze the performance of specific NCEs, to perform this essential function. Another option would be to consider a more academic approach whereby an academic or team of academics would help define and measure network achievements. The Excellence Initiative in Germany, for example, conducted a competition for professors to oversee the development of performance indicators among its Clusters of Excellence and Institutional Strategies for Top-level University Research, which has proven highly successful.

In order to improve the utility of current performance indicators and to reflect international benchmarks in this area, the NCE-IAC strongly advises the NCE to undertake the following:

### **Recommendation 17**

The NCE Secretariat should organize a workshop with international experts on how to develop a performance framework and new measures for networks. The NCE Secretariat could also consider hiring either a specialized firm or a team of academic researchers to develop a better framework for performance evaluation.

## FOCUSING FUTURE COMPETITIONS FOR STRATEGIC INVESTMENT

### Aligning the NCE Program with Government Priorities in the Short Term

An important driver in the selection of strategic areas is the federal government's group of top priorities. In setting such priority areas, Canada joins a growing number of nations worldwide, including the US, the UK, Australia, Finland, New Zealand, Korea, Italy, and Iceland. Each of these countries has identified areas where they can compete on the world stage on the basis of world-class research excellence. The priority-setting process undertaken by these countries included identifying societal needs and then delivering results to meet those needs through a competitive process. It is a model that the Government of Canada has replicated through the introduction of its recent S&T strategy, *Mobilizing Science and Technology to Canada's Advantage*.

Currently, the areas of research priorities that Canada has identified in the recent budget are centered on four general themes:

- Environmental science and technologies;
- Natural resources and energy;
- Health and related life sciences and technologies; and
- Information and communications technologies.

These priority areas were identified as fields that Canada currently delivers S&T research at or nearing international levels of excellence and that are important to Canada's long-term success.

Considering the current government priorities, the NCE-IAC strongly recommends that the NCE program focus on these priority areas for the upcoming competition. The target areas

should remain sufficiently broad to attract the best possible researchers and provide the opportunity for a range of diverse proposals to emerge. In order to achieve this goal, the NCE-IAC advises the implementation of the following recommendation:

#### Recommendation 18

The next NCE competition (e.g., business-led and academic-led NCEs) should be targeted to align closely with the federal government's four strategic S&T priorities (i.e., environmental science and technologies; natural resources and energy; health and related life sciences and technologies; and information and communications technologies) as outlined in *Mobilizing Science and Technology to Canada's Advantage*. The target areas should remain sufficiently broad to attract the best possible researchers and provide the opportunity for a range of diverse proposals to emerge.

### Balancing Academic, Industry, Social, and Government Priorities in the Future

In the future, the NCE program will likely face a critical challenge when selecting targets for the creation of new networks for funding: Researchers' preferences must be balanced with society's needs, while at the same time increasing the translation of research strength into innovation strength. Participants in the Blue Sky discussions also spoke of the importance of focusing networks so that they address a need, gap, or problem of importance to Canadian society. The participants raised the concern that if competitions are too highly focused, or too targeted, they may overlook vital research areas not currently identified as a priority. The

NCE-IAC expressed concern that if the selection criteria are too broad or too many networks are funded, the ability of the NCE program to meet its goals would be watered down with research funds spread too thinly. The final piece in this complex puzzle is the need to reflect industrial needs in order to achieve a Canadian economy that is more supportive of R&D investment and, ultimately, more innovative. The NCE-IAC identified three criteria that need to be considered when selecting specific target areas for new NCEs:

- Research capacity and excellence in Canada;
- Need to know particular industry sector requirements and potential for research to materially affect its future prospects; and
- Societal needs or the strategic economic priorities of the country.

Many nations have been engaged in the process of doing foresight exercises or consultation to determine critical research areas. The National Institute of Science and Technology Policy (NISTEP) in Japan, for example, has been conducting what it calls “Delphi analyses” roughly every four years since the 1970s. Through repeated discussions among more than 170 experts in 13 field-specific subcommittees, the design of the most recent NISTEP Delphi analysis (May 2005) covered 130 areas and the 858 topics that represent them. Furthermore, the analysis was informed by a questionnaire, which was filled out by 2,300 Japanese researchers, engineers, and other experts, that surveyed scientific and technological, economic, and social impacts in each area, as well as the level of R&D in Japan. Similar exercises have also been carried out in the UK, the US, the Netherlands, and Australia.

Introducing business-led networks, increasing partnerships and collaborations between industry, academic, and other stakeholders, and

conducting a foresight exercise will ensure that the NCE program’s future direction is well balanced among all of its stakeholders. The NCE-IAC also recommends that the new Tri-Agency Private Sector Advisory Board be involved in the development of guidelines for future competitions.

Furthermore, the NCE-IAC recommends that the NCE Steering Committee routinely consult with the Tri-Agency Private Sector Advisory Board and NCE stakeholders in academia and industry to redefine its agenda. The boards of the UK’s Economic and Social Research Council have been conducting consultations in this manner for several years and the consultations are now part of a much larger process aimed at providing data to help the government align its priorities into successive EU Framework programs.

In order to assist in the focusing of government research priorities, the NCE-IAC advises the NCE to participate in government foresight exercises as follows:

### **Recommendation 19**

The NCE Secretariat, the Tri-Agency Private Sector Advisory Board, the Canadian Academies of Science, and perhaps, the newly created Science, Technology, and Innovation Council should be involved in a periodic government-led foresight exercise to identify the government and program’s long-term research priorities. The NCE-IAC also recommends that the new Tri-Agency Private Sector Advisory Board be involved in the development of guidelines for future NCE competitions.

## CONCLUSION

The NCE program is a recognized leader in bringing researchers from multiple sectors and disciplines together to create effective problem-focused research networks. In an era of increasing complexity and interdependencies, there is no question that the NCE program is and should continue to be an integral element of Canada's S&T strategy. It was with this in mind that the NCE-IAC undertook its review and framed the recommendations contained within this report. The recommendations do not seek to replace the existing NCE program, but to advance it forward in a direction that will build on its prior successes and help secure Canada's place on the world S&T stage. The research undertaken by the NCE networks will remain critical to helping Canada meet the priorities and answer the problems, new and old, that will challenge the nation in the future.

The NCE program is the only granting agencies' program that specifically brings together researchers and other stakeholders from such a wide range of disciplines. It is a unique funding mechanism that allows the federal government to fund research that is both research-driven—through the academic-led networks—and market-driven—through the newly created business-led networks. The federal government has recognized the unique contribution of the NCEs through the new investments in the NCE program announced in the *Advantage Canada* economic plan.

The NCE-IAC recommendations were designed to help align Canada's S&T research spending through the NCE program so that it supports increased commercialization and knowledge translation. The improvements recommended will enhance the program, increasing

partnerships across Canada and across the world, and allowing Canada to leverage S&T research and breakthroughs being generated within Canada, as well as those taking place in other countries. In doing so, the recommendations support university researchers, industry, government, and not-for-profit stakeholders across Canada to achieve world-class excellence, as well as producing tangible benefits for all Canadians.

The NCE-IAC looks forward to the adoption of these recommendations so that the NCE program and Canada can yet further enhance its leadership in S&T research developed through collaborative partnerships.

**CONCLUSION**



## APPENDIX 1: THE NCE-IAC COMMITTEE

### Chair:

#### **Dr. Roderick D. Fraser**

President Emeritus, University of Alberta, Canada

Dr. Fraser was president of the University of Alberta from 1995 to 2005. Under his leadership, the university made great strides towards fulfilling his vision of becoming “indisputably recognized in teaching, research, and community service, nationally and internationally, as one of Canada’s finest universities, and amongst a handful of the world’s best.” In the years Dr. Fraser was president, annual research revenues surged from \$86 million to over \$300 million.

Previously, Dr. Fraser was vice-principal (Resources) at Queen’s University in Kingston (1988 to 1994) and professor of economics at Queen’s, where he served as dean of their Faculty of Arts and Science from 1983 to 1988.

Dr. Fraser has also played an integral role in the decision to have Edmonton and the University of Alberta chosen as host to the \$120 million National Institute for Nanotechnology. This national institute will be a world-class centre for nanotechnology research attracting a core of the world’s best minds in the field.

Dr. Fraser is an officer of the Order of Canada, and has been decorated with the Order of the Rising Sun, Gold Rays with Neck Ribbon by the Japanese government.

### Members:

#### **Dr. Howard Alper**

Visiting Scientist — International Development Research Centre (IDRC)

Distinguished University Professor, University of Ottawa, Canada

Dr. Alper has published 487 papers, holds 37 patents, and has edited several books. He has served on many NSERC committees (e.g., Committee on Research Grants), and as chair of the Partnership Group for Science and Engineering (PAGSE). He is actively engaged in policy creation and implementation for research and innovation in Canada and abroad.

Dr. Alper chairs the Steacie Prize committee (NRC), and is a member or chair of several corporate boards. In 2004, he was elected to a three-year term as co-chair of the InterAmerican network of Academies of Science (IANAS). In 2005, he was elected chair of the board of the Council of Canadian Academies. He also represents Canada on the North Atlantic Treaty Organisation (NATO) Science Committee.

In 1996 Dr. Alper was appointed as a titular member of the European Academy of Arts, Sciences, and Humanities, and in 1999 as an officer of the Order of Canada. He was named president of the Royal Society of Canada (RSC) for a two-year term commencing November 2001, and is currently foreign secretary of the RSC: The Academies of the Arts, Humanities, and Sciences of Canada. As foreign secretary, Dr. Alper represents RSC to the G8 Academies. He is intimately involved in S&T for African development (e.g., New Partnership for Africa’s Development [NEPAD]).

**Dr. Michael N. Barber****Group Executive****CSIRO and Information, Manufacturing & Minerals (IMM) Group, Australia**

Dr. Barber, an applied mathematician and theoretical physicist by training, is responsible for overseeing eight divisions at the IMM Group and the Light Metals Flagship in the impact domains of astronomy, information and communications technologies, minerals, manufacturing, security, health, energy/environment, and services. From December 2002 to June 2006, Dr. Barber was CSIRO executive director, science planning. He worked to ensure CSIRO's leadership in scientific and technological excellence.

From 1996 to 2000, Dr. Barber was a member of the Australian Research Council (ARC), which included periods as chair of the ARC's Joint Research Grants & Fellowship Committee and Research Training and Careers Committee. He was also secretary, science policy, of the Australian Academy of Science (2001 to 2005). In January 2008, he will become vice-chancellor and president of Flinders University of South Australia.

**Dr. Klaus Bock****Professor, Coordinating Head of Carlsberg Laboratory and Vice-President for Research and Development, Denmark**

Dr. Bock joined Carlsberg in 1988 after more than 15 years as associate professor in organic chemistry at the Technical University of Denmark, including assignments as visiting professor at the University of British Columbia (UBC) in Vancouver and NRC in Ottawa, Canada, and at the universities of Alberta (Canada), Hamburg (Germany), and Grenoble (France).

Dr. Bock has received several international research awards and is a member of many Danish and international scientific committees and societies. He serves on the editorial board of international journals in the field of carbohydrate chemistry and is chairman of the Board of Trustees of the Danish National Research Foundation, chairman of the Danish National Coordination Committee for Research and vice-chairman of the Board of Trustees of the Danish National Advanced Technology Foundation. Dr. Bock holds a PhD in organic chemistry from the Technical University of Denmark.

**Dr. C. Thomas Caskey****Chief Operating Officer (COO) and Director and Chief Executive Officer (CEO)-Elect, the Brown Foundation for Molecular Medicine for the Prevention of Human Diseases****Executive Vice-President for Molecular Medicine & Genetics, University of Texas Health Science Center at Houston, US**

Dr. Caskey has received numerous academic and industry-related honours. He was founding director of Houston-based Cogene Biotech Ventures and Cogene Ventures, venture capital

funds supporting early-stage biotechnology and life sciences companies. He serves on the boards of several corporations, and is director of the Washington Advisory Group, which provides management and strategy consulting services.

Previously, Dr. Caskey served as president of American Society of Human Genetics, the Human Genome Organization and The Academy of Medicine, Engineering and Science of Texas (TAMEST). He was also senior vice-president for Human Genetics and Vaccines Discovery at Merck Research Laboratories from 1994 to 2000 and president of the Merck Genome Research Institute from 1998 to 2000.

Dr. Caskey earned his medical degree from Duke University School of Medicine.

### **Dr. Per Eriksson**

**Director General, Vinnova—Swedish Agency for Innovation Systems, Sweden**

Dr. Eriksson received a Master of Science degree in Electrical Engineering from the Lund Institute of Technology and in 1981 was awarded a Ph.D. in Telecommunications. From 1980 until 1989, he was the founder, president, and chairman of the boards of consultancies in signal processing and acoustics. In 1981, he became assistant professor in telecommunications and signal processing in Lund Institute of Technology. He was the director of undergraduate studies in electrical engineering, Lund Institute of Technology from 1981 to 1987.

From 1983 to 1988, Dr. Eriksson was dean and chairman of the Board of Undergraduate Studies in Electrical Engineering, Technical Physics, and Computer Engineering, in the Lund Institute of Technology. From 1989 until 2000, he was appointed as the first president of the new Blekinge Institute of Technology.

### **Dr. Michael Gibbons**

**Honorary Professor, Director of Science and Technology Policy Research (SPRU), University of Sussex, United Kingdom**

Dr. Gibbons retired as secretary general of the Association of Commonwealth Universities in August 2004. Prior to this, he was founding director of the program of Policy Research in Engineering Science and Technology at the University of Manchester and director of research and technology transfer in that university.

Dr. Gibbons has been predominantly active in S&T policy research but has also carried out research on the process of technological innovation in industry and the evaluation of research. He is co-author of two major books on the nature of contemporary science: *New Modes of Knowledge Production*, and *Re-thinking Science*. South African authorities have vigorously taken up his work, adapting the notion of Mode 2 research in the transformation of the South African higher education system. From 2000 to 2003, Dr. Gibbons was a member of the UK Economic and Social Research Council and chair of its Research Priorities Board.

Dr. Gibbons has acted as a specialist advisor for the UK Parliamentary Science and Technology Committee, and has been a consultant with the OECD for many years.

**Dr. Louise Proulx**

**Vice-President Product Development,  
ViroChem Pharma, Canada**

Dr. Proulx joined Virochem Pharma in 2006. She has nearly 30 years of experience in research and scientific management, predominantly in the fields of cancer and antivirals. She has held several scientific positions of increasing responsibilities, notably as vice-president at Hoechst Marion Roussel Canada, BioChem Pharma, Génome Québec, and Topigen Pharmaceuticals Inc.

Dr. Proulx has also held the position of vice-principal research at McGill University. She is a member of a number of boards of directors, including GeminX Biotechnologies Inc. and DiagnoCure Inc. Dr. Proulx holds a Ph.D. in physiology from the Université Laval and has completed post-doctoral studies at the Karolinska Institute in Stockholm.

**Dr. Ernst-Ludwig Winnacker**

**Secretary General, European Research Council,  
Belgium**

Dr. Winnacker has been a professor of biochemistry at the University of Munich since 1977, and a visiting professor at Harvard Medical School since 1990. He has served as president of the German Research Society from 1998, where he was previously vice-president. He was chairman of the Laboratory of Molecular Biology at the University of Munich from 1984-97 and was a member of the Enquête-Commission of the German Parliament on the chances and risks of recombinant DNA. He is a member of numerous academies of science, including the Institute of Medicine (IOM) of the National Academies (US). Professor Winnacker's main research fields are the molecular biology of DNA replication, DNA recombination, and prion diseases. He has published more than 100 articles and several books, among them: *From Genes to Clones* and *The Genome*.

He was the president of the Deutsche Forschungsgemeinschaft and in January 2007 became the first secretary general of the European Scientific Council (ERC).

## APPENDIX 2: TERMS OF REFERENCE OF THE NCE-IAC

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In addition to the regular five-year program evaluation taking place this year that assesses the achievements of the program against its stated objectives, the NCE Steering Committee has requested that a higher level review of the program goals, expectations, and niche be carried out by an international committee.

The mandate of the NCE-IAC is to provide advice to the NCE Steering Committee on future strategic opportunities for the NCE program and the next competition. The tasks of the IAC will be complementary to the NCE evaluation and will provide advice on the following items:

1. The niche of the NCE program (i.e., current strengths, gaps, and weaknesses) vis-à-vis other similar Canadian and international programs, and how the program should evolve for its next phase (2007-12) including sub-questions such as value-added, strategic use of the program, areas of investment, and scope of future NCEs; and
2. The framework of the 2008 NCE competition (e.g., targeted or not, if yes, which target areas; should more emphasis be put on certain program elements such as increased level of partnerships, commercialization).

Without limiting the potential extent of the review, the NCE Steering Committee seeks advice and recommendations on the following:

### Niche of the NCE program

1. What would be the optimal spectrum and proper balance of activities to be funded by a network (from basic research to commercialization, long-term versus short-term research, training of highly qualified entrepreneurial personnel, and support of proof of concept)?
2. In a network and in an effort to increase Canada's productivity, how could the NCE program best manage the dynamic/natural tension between the involvement of the best researchers and the best fundamental science with the Canadian industry/user sector needs?
3. How can the NCE program best involve the industry or the user sector in a network? Should the NCE program encourage them to be full participants before the application stage with firm contributions (e.g., specific user sector matching funds)?
4. How can the NCE program stimulate and encourage networks to develop an entrepreneurial culture (e.g., training of highly qualified entrepreneurial personnel) to further develop added value activities (e.g., knowledge and technology transfer)? And how does the NCE continue to achieve these goals?
5. How can the networks help fulfill the mandate of the granting agencies and Industry Canada?
6. How can the NCE program better measure the impact of the program and the networks?

7. To be more competitive on the international scene, how should the NCE program and the networks go global and take advantage of the best research in the world to apply it in Canada? Are there elements of other international programs that could be included in the NCE program that will help Canada increase its productivity?
8. Are the NCE evaluation criteria still relevant?
9. Are there suggestions on how to improve governance and program delivery?

### Next Competition

1. What should be the selection criteria for the next generation of new networks?
  - Multidisciplinarity— is this key to all?
  - Research driven or problem driven?
  - Should the choice of sector be determined beforehand?
  - Need for an international component?
  - Need to increase level of partnerships?
  - Need to increase level of commercialization or knowledge transfer?
2. Are there any key sectors currently not represented or gaps not covered by the NCE program?
3. What kind of best practices exist on how to determine the target areas?
4. Should the program go towards a set of diverse models that fit different needs (e.g., glue-type networks, research-driven networks, business-driven networks, international networks)?

5. How can the NCE program be used more strategically to meet the challenges faced by Canada (e.g., productivity and innovation gap)? Are there unmet opportunities for the future?

The Committee will produce a report for the NCE Steering Committee that will include an analysis of the program's current position and a series of recommendations for the future.

### Membership

The NCE -IAC was appointed by the NCE Steering Committee. The Committee is composed of nine members including a Chair.

The Committee members are

- highly accomplished senior research and program directors from different sectors (university, private, public, and not-for profit) having experience in or knowledge of collaborative research and knowledge transfer;
- highly accomplished individuals representing the diversity of S&T disciplines (health, social science, and natural sciences and engineering);
- have experience in multidisciplinary/multisectoral research organizations or network-like organizations, or both;
- have played a major role in a transformation of the approach used to support research or foresight exercises; and
- represent the full breadth of the NCE program objectives (e.g., research, HQP training, networking and partnerships, knowledge and technology transfer, management).

### Timetable of Activities

The target date for completion of the review will be mid June 2007. A final report will be submitted to the Steering Committee by the end of June 2007. This will ensure that findings are available for integration, as appropriate, into the future terms and conditions of the program, the framework of the next NCE competition, and to help plan future activities of the program.

Major Activities	Deadline	Result
Assemble NCE International Advisory Committee	December 2006	NCE Steering Committee approval
1st meeting of the Committee	February 2007	Introduction to the program and stakeholders and input on needs for the Committee
2nd meeting of the Committee	End of April/early May	Discussions and draft final report
Final report	July 2007	Final report presented to NCE Steering Committee

### Roles and Responsibilities

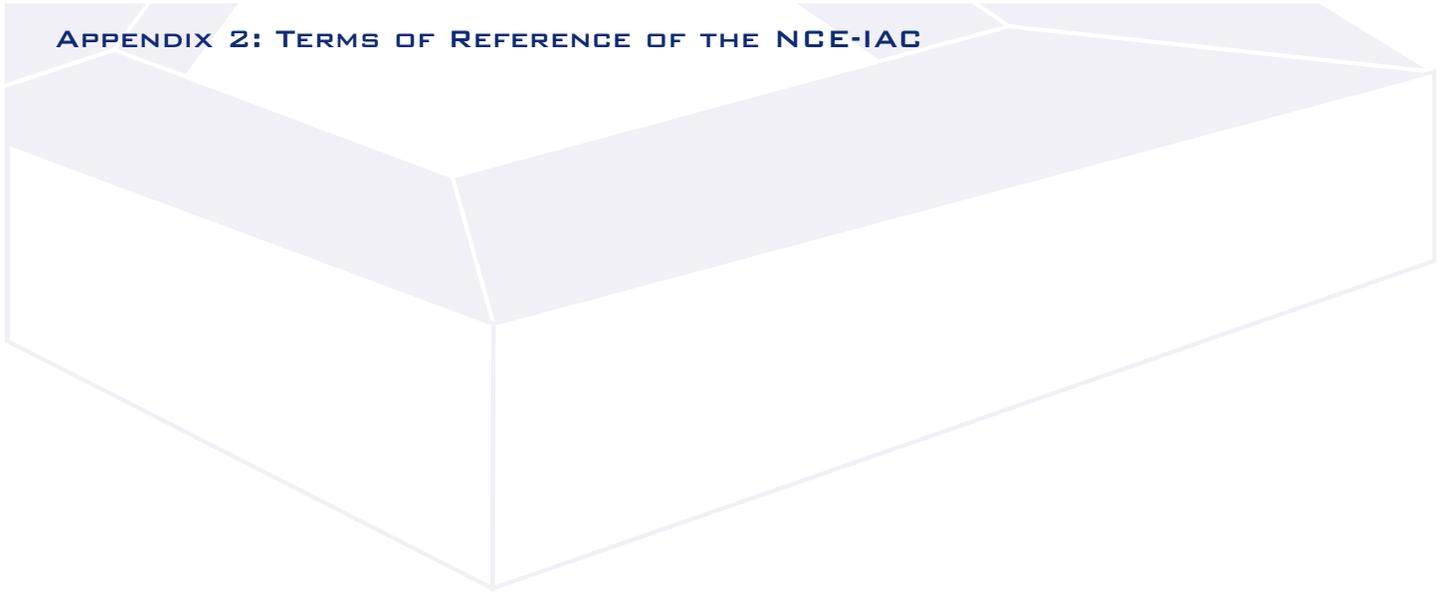
The NCE Steering Committee is accountable and responsible for establishing the terms of reference of the NCE-IAC, approving its membership, and receiving and responding to the preliminary and final reports.

The NCE-IAC will be responsible for conducting the following activities:

- Reviewing existing materials on the program and relevant background documents;
- Meeting with Steering Committee members, NCE staff, NCE representatives, and others, if deemed appropriate;
- Analyzing and interpreting results and drawing conclusions; and
- Making recommendations through preliminary and final reports to the NCE Steering Committee.

NCE staff will manage the overall process, including

- proposing members for the NCE-IAC to the NCE Steering Committee;
- providing operational support to the NCE-IAC;
- interacting with the Steering Committee, Management Committee, granting agencies staff, and other stakeholders;
- retaining consultants to help with report drafting and other tasks, as requested; and
- gathering information, opinions, and comments as requested by the NCE-IAC.



## APPENDIX 3: THE NCE-IAC REVIEW PROCESS

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The NCE-IAC held two face-to-face meetings in Ottawa over a period of three months in early 2007. The first was held from February 7 to 9, and the second was held from April 29 to May 1, 2007.

Prior to these meetings, the NCE Secretariat provided the NCE-IAC members with an extensive collection of background documents (see background documents below for a complete summary) including the Blue Sky Report, which details the outcomes from a one-day workshop (December 5, 2006) involving 125 NCE leaders, partners, and government officials on the future direction of the NCE program. The report was circulated to a wider audience of stakeholders (i.e., NCE partners from government, academia, and industry) in January 2007, as a means of stimulating new ideas and comments on the strengths, value added, and opportunities for future networks and the NCE program. The results of this consultation process were also forwarded to the IAC prior to the first meeting.

The purpose of the first meeting was to allow the committee members to assess the current status and niche of the NCE program while also discussing future prospects. The committee members heard presentations from NCE Steering Committee members and the NCE Director, the Conference Board of Canada, selected NCE Boards of Directors, Chairs, and Scientific Directors, NCE Host Universities representatives, as well as senior officials from federal SBDAs.

Following these presentations, the NCE-IAC discussed several issues that were brought forward during the two-day session and began deliberations on the future direction of the NCE program. The discussion encompassed a variety of topics including creating business-driven networks; increasing knowledge and technology exchange and exploitation activities; targeting NCEs in emerging areas of science; expanding partnerships, especially with international groups; exploring the concept of centres of excellence; and measuring the impacts of the NCEs. Between the two meetings, the Chair held a series of conference calls with each member to get their agreement on the minutes of the first meeting and further discuss their involvement and how to best approach the April meeting.

During the second meeting, the NCE-IAC shared their own experiences in evaluating, revitalizing, or constructing programs similar to the NCE program in their respective countries. Additionally, various presentations were made from selected representatives from industry as well as the contracted consultant to carry out the NCE program evaluation. Furthermore, the NCE-IAC discussed other topics related to how the NCE program could maximize the efficiency and improve the delivery of the current and new NCE programs, as well as how the NCE could be more strategic in its approach to future competitions. Discussion was held with the NCE Steering Committee with regards to the outcomes of the NCE-IAC review, and to close the meeting, the NCE-IAC deliberated on the final recommendations.

An alphabetical listing of presenters from both the February and April/May meetings is provided on the following page.

### APPENDIX 3: THE NCE-IAC REVIEW PROCESS

<b>Bernstein, Alan</b>	President, Canadian Institutes of Health Research and member of the NCE Steering Committee
<b>Borland, Bill</b>	Chair of Board of Directors, Canadian Water Network
<b>Bossé, Judith</b>	Assistant Deputy Minister, Canadian Food Inspection Agency
<b>Chowaniec, Adam</b>	Chair of Board of Directors, Tundra Semiconductor Corp.
<b>Elvidge, Eric</b>	Chair of Board of Directors, Canadian Stroke Network
<b>Fortier, Suzanne</b>	President, Natural Sciences and Engineering Research Council and Chair of the NCE Steering Committee
<b>Gaffield, Chad</b>	President, Social Sciences and Humanities Research Council and member of the NCE Steering Committee
<b>Gauthier, Benoît</b>	Circum Inc.
<b>Gavrel, Jean-Claude</b>	Director, NCE program
<b>Gupta, Arvind</b>	Scientific Director, Mathematics of Information Technology and Complex Systems Network
<b>Halliwell, Janet</b>	Vice-President and COO (representing Chad Gaffield, President, SSHRC)
<b>Hodgson, Glen</b>	Chief Economist, Conference Board of Canada
<b>James, Doug</b>	Chair of Board of Directors, Canadian Institute for Photonic Innovations
<b>Joseph, Helen</b>	Representing Wendy Watson-Wright, ADM, Department of Fisheries and Oceans
<b>Kesselman, Joanne</b>	Vice-President Research, University of Manitoba (NCE Host Universities Representative)
<b>Kurji, Feyrouz</b>	Director of Knowledge Infrastructure, Industry Canada
<b>Mann, John</b>	Director of Engineering and Regulatory Affairs, DaimlerChrysler Canada Inc.
<b>O'Brien Fehr, Kevin</b>	Director, R&D Alliances, GlaxoSmithKline Inc.
<b>Patry, Gilles</b>	President and Vice-Chancellor, University of Ottawa (NCE Host Universities Representative)
<b>Pinto, Mario</b>	Vice-President Research, Simon Fraser University (NCE Host Universities Representative)
<b>Rudnicki, Michael</b>	Scientific Director, Stem Cell Network

<b>Steger, Debra</b>	Scientific Director, Emerging Dynamic Global Economies Network, New Initiative
<b>Stewart, Iain</b>	Director General, Innovation Policy Branch (representing Richard Dicerni, Deputy Minister, Industry Canada)
<b>Yada, Rickey</b>	Scientific Director, Advanced Foods and Materials Network
<b>Walden, Janet</b>	Vice-President, Research Partnerships Programs and Chair of the NCE Management Committee

### Background Documents

The IAC was provided with a series of background documents to assist them in conducting their review of the NCE program. The documents were submitted to the IAC members in three volumes, the contents of which are listed below.

#### Volume 1: NCE Background Documentation

- Agenda and Committee Membership List
- Terms of Reference
- Biographical Profiles—NCE International Advisory Committee, Steering Committee, and Management Committee
- NCE Program Guide
- NCE Funding Agreement and NCE Network Agreement
- Excellence (NCE Newsletters)
- 2006–07 NCE Fact Sheet
- Blue Sky Discussion: The Future Direction of the Networks of Centres of Excellence

#### Volume 2: NCE Background Documentation

- Canadian Research Funding Landscape and the NCE Program
- *The State of Science Technology in Canada*. Council of Canadian Academies (September 2006) <<http://www.scienceadvice.ca/study.html>>
- *Advantage Canada: Building a Stronger Economy for Canadians*. Department of Finance Canada (November 2006) <<http://www.fin.gc.ca/ec2006/plan/pltoce.html>>
- Current Views from Selected Funding Agencies
- Responses and Comments to the Blue Sky Report—Executive Summary
- Responses and Comments to the Blue Sky Report from NCE Networks, Assistant Deputy Ministers, CIHR Scientific Directors, and Vice-Presidents of Research of Canadian Universities

#### Volume 3: NCE Background Documentation

- Highlights & Detailed Minutes of the NCE-IAC's First Meeting
- 2007 Canadian Federal Budget—Summary & Chapter 5, "Knowledge Advantage"

- AUCC Submission to the Minister of Industry & Minister of Finance on the Development of an S&T Strategy for Canada
- NCE Results-based Management and Accountability Framework
- NCE International Advisory Committee, Information on the Texas Programs, Provided by Dr. C. Thomas Caskey, April 2007
- NCE International Advisory Committee, Information on the German and Swiss Programs, Provided by Dr. Ernst-Ludwig Winnacker, April 2007
- NCE International Advisory Committee, Information on the Swedish Programs, Provided by Dr. Per Eriksson, April 2007
- NCE International Advisory Committee, Presentation from Dr. Louise Proulx on Industry Participation, April 2007
- NCE International Advisory Committee, Presentation from Dr. Klaus Bock, Danish Research Funding System, April 2007
- NCE International Advisory Committee, Information on the Australian Programs. Provided by Dr. Michael Barber, April 2007

The NCE-IAC also received and reviewed documents from the CIHR, the Ontario Centres of Excellence, the Canadian Institute for Advanced Research (CIAR), NSERC on their seven target areas of strategic direction for their programs, and CSIRO (i.e., CSIRO's outcome reporting).