

Submission in response to the House of Commons' Standing Committee on Industry and Technology's study on Quantum Computing

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IBM Canada LTD



The following submission is filed by IBM Canada Ltd., in response to the House of Commons' Standing Committee on Industry, Science and Technology's ongoing study of quantum computing.

Introduction

IBM has been in Canada over 100 years. In fact, Canada was the first country outside of the United States that IBM operated in. Today, IBM is proud to contribute to Canada's technology ecosystem in many ways. We operate one of the largest IBM semiconductor assembly and testing facilities in the world. We operate the largest software development lab in Canada. And we are contributing to Canada's quantum computing ecosystem in significant ways as well.

Quantum computing has the potential to solve our most complex challenges; challenges of a different realm than what the world's most powerful supercomputers can solve today. For a growing number of Canadian businesses, researchers and governments, proficiency in quantum computing is becoming urgent as the technology begins to move from beyond laboratory science to real-world applications.

Real world applications of quantum are being explored right now in industries like financial services to better predict the complexity of the markets and improve fraud detection and risk analysis. Other near-term applications of quantum technology could include simulating chemical reactions to discover tomorrow's sustainable batteries and carbon capture technologies.

Quantum computing: a multidimensional Canadian ecosystem ready for the challenges of tomorrow

According to the National Research Council of Canada, by 2030, Canada is expected to grow an \$8.2 billion quantum technology industry, employing 16,000 people. By 2040, quantum technology is expected to reach 50% adoption, growing into a \$142.4 billion industry and sustaining 229,000 jobs in Canada.

While it took classical computing many decades to mature to the sophisticated cloud-based services of today, quantum computing could take this same leap in just a few years. Co-existing within a conventional computing environment, quantum is poised to reinvent the worlds of business, science, education, and government in fundamentally new ways. While quantum computing is fundamentally different than the classical computing we recognize today, it's important to note that it will be the combination of these technologies that will fuel

the predicted breakthroughs. Investments in AI, machine learning and other advanced technologies will continue to have significant benefits.

The federal government announced in Budget 2021 a \$360 million funding commitment to build a National Quantum Strategy, an announcement that we welcomed with anticipation. Indeed: the federal government's involvement is a crucial to the foundation of an ecosystem that has already nurtured and solidified partnerships with provinces, research, and industries.

IBM: Pairing Quantum with the best of Canada

One of the core principles IBM believes is necessary to ensure an effective strategy is that open-source access and adoption is how an ecosystem of developers, scientists, educators and professionals across different industries will become quantum-ready. And we have put this vision in practice.

IBM Canada is proud of recent announcements we have made in the field of quantum computing. Our goal is to build upon these announcements, with our partners, to expand their impact across Canada.

- In 2020, IBM expanded its Quantum Network in Canada by launching a Quantum Hub at the Université de Sherbrooke's Institute Quantique. This joint team of IBM quantum experts will work with researchers and businesses, including CMC Microsystems, to provide cloud-based access to the world's most advanced quantum systems. This serves as a good example of the collaborative approach to quantum computing IBM Canada supports to ensure Canadians are ready when quantum fully integrates into our industries. A priority must be to develop more mathematicians and physicists who can work deeply within a quantum system to optimize performance. But we also need front-end, quantum-proficient software developers who can tune the technology to focus on practical uses as well as business professionals who can translate business needs to use with this emerging technology.
- In February of this year, in partnership with the Government of Quebec, IBM announced plans to launch a Discovery Accelerator, the first of its kind in Canada. A Quantum System One computer will be installed in the province, alongside a new HPC cluster for AI, to help accelerate research in sustainability, therapeutics, and semiconductors amongst several topics. We are aiming to create a community built upon open scientific research in Quebec. The necessity for accelerating discoveries has never been clearer and the ability to do so with AI, quantum computers, and high-performance computers has never been greater. This agreement truly captures the

synergy between the Quebec government (headed by Premier François Legault) and IBM leadership (which included Senior Vice President and world-renowned quantum expert Dario Gill, who came to Bromont for this momentous occasion). With this Quebec-IBM Discovery Accelerator, not only does the province position itself for the discovery of major breakthroughs: this agreement will also be a key catalyst for discovery in Canada.

This new initiative will be built on the foundation of our 2020 announcement with the Université de Sherbrooke and our ongoing partnership with Mila, the leading AI research institute based in Montreal, to accelerate the development of trusted, open-source AI capabilities, and demystifying the “black box” nature of machine learning models. Our development and manufacturing facility in Bromont will host the IBM Quantum System One, only the fifth client-dedicated IBM quantum system installed in the world and the first gated-based quantum computer installed in Canada.

IBM Canada believes these announcements will become building blocks for the quantum computing ecosystem in Canada. As a supporter of open source and open scientific research, we welcome others to join.

A Call to Action

Specific to Canada’s National Quantum Strategy, IBM Canada released a whitepaper in May 2021 with six key focus areas for all stakeholders:

1. **Attracting and retaining highly qualified personnel**
Through academic training and incentives, retain our existing talent and bring new quantum-proficient technical professionals to Canada.
2. **Deepening collaboration across government, academia, and industry**
Governments should foster practical collaborations between leading private sector firms and academia, such as at the IBM Quantum Hub in Sherbrooke, to ensure sustainable academic and commercial ecosystems. It is critical that Canadian companies are prepared for changes to their competitive environment in the quantum future.
3. **Manufacturing quantum hardware and components**
Canada’s leadership position in quantum technology can be strengthened by manufacturing even more advanced hardware and components, thereby securing important ingredients of the hybrid computing and quantum supply chain.

4. Hosting world-class quantum computers

Hosting world-class quantum computers in secure facilities on Canadian soil will provide dedicated, broad access to academic and government researchers, and industry experts, as well as assist quantum startups in scaling their companies. We congratulate the Government of Quebec for taking the first step with us in the Quebec-IBM Discovery Accelerator in their recently announced Sherbrooke Innovation Zone.

5. Leveraging our hybrid computing expertise

Talent and resources at existing high-performance computing systems across Canada should be leveraged to transition research and industry towards quantum applications as capabilities increase.

6. Fostering a coordinated ecosystem of quantum enabling technology

A coordinated ecosystem will allow for the rapid dissemination of quantum computing capabilities across industries through pan-Canadian ecosystems and partnerships. Quantum software and algorithm development, middleware and specific industry applications that bring competitive advantage will thrive once the foundations of the quantum landscape are in place.

Conclusion

As it seeks to gain a true competitive advantage in the race to develop quantum technologies, Canada has various enviable intangibles: a highly skilled, diverse workforce; a renowned and vibrant research community; an innovation-centric approach; and finally, a genuine resolve to forge ahead.

These ingredients only need to be supplemented by bold, ambitious funding streams, to sustain the investments made by provinces, research, and private interests. Each component is key to the vibrancy of the ecosystem, as it is to the ultimate success in finding solutions to everyday and future problems.

IBM Canada can leverage a lot of lessons learned from its successes in creating a strong and global quantum ecosystem, including in countries which have dedicated quantum computer installations such as Germany, the United States, Korea, and Japan, as many of these lessons are not country specific. Canada's competitive advantage in terms of quantum technology, highly skilled and diverse workforce, training capacities and research makes it an ideal partner for IBM in the race for building scalable quantum technologies.

IBM Canada thanks the INDU Committee for listening to its views and would welcome

opportunities to expand on these various points as the 44th Parliament continues to examine ways for Canada to fully benefit from the great potential of quantum computing.