August 4, 2023

Submission for the Pre-Budget Consultations in Advance of the Upcoming Federal Budget

Xanadu Quantum Technologies Inc.
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Recommendation 1: Direct Innovation, Science & Economic Development Canada (ISED) to formalise a Public/Private Partnership to establish a **Canada Quantum Computing Centre** through a set series of staged investments. This computing centre would be the first major hub of its kind in the world, secure hundreds of new jobs and affirm a talent pipeline and job creation through research, operations, and maintenance. The initiative follows closely with the House Finance Committee's 2021 Pre-Budget recommendation to dedicate financial support to the establishment of a quantum computing research institute in the Toronto area. The quantum industry and academic partners are already committed to realising a Canada Quantum Computing Centre. Earlier discussions with the Federal Government suggest receptivity; however, we encourage the Federal Government to officially join this initiative and dedicate funds to realise this public-private partnership.

Recommendation 2: To help facilitate the commercialization success of Canadian innovation and research, establish a nationally-coordinated funded program for quantum computing software education to promote work-integrated-learning opportunities in quantum information science and technology. By establishing such a program, the government would help accelerate and incubate a strong talent pipeline for Canadian businesses and government to help facilitate the commercialization of Canadian quantum R&D and IP. Canada has a strong academic base of quantum researchers but the quantum industry's demand for qualified employees far outstrips the supply, forcing quantum companies to constantly source talent outside the country. Upskilling of the existing Canadian tech workforce is an attractive complement to meet industry needs.

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Standing Committee on Finance
House of Commons
Ottawa ON
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Via email: FINA@parl.gc.ca

To the House Finance Committee:

Xanadu Quantum Technologies is pleased to provide comments in response to the 2024 pre-budget consultations. This submission outlines investment and policy recommendations to help create jobs, grow our innovation economy, and secure a globally competitive quantum technology sector in Canada.

Who we are:

Xanadu is a leading Canadian quantum company. Our mission is to build quantum computers that are useful and available to people everywhere. Our company, founded in 2016, has grown into one of Canada's largest quantum technology companies and over the past five years we have rapidly expanded to include over 180 quantum scientists and engineers. We plan to continue growing our team in 2023 and beyond. Our growth as a company was also bolstered this past January by a $40M investment by the Government of Canada to help build the world's first photonic-based, fault-tolerant quantum computer.

The Government of Canada's investment follows other recent notable achievements for our company. For example, in June 2022, the prestigious science journal *Nature* published peer-reviewed research from Xanadu demonstrating that we had built the world's most powerful quantum computer at that time, for a specific task. This achievement is a major milestone for both Xanadu and Canada's quantum computing industry. This new quantum computer, which Xanadu has called Borealis, accomplished a specific task in a fraction of a second that would take the world's fastest supercomputer 9,000 years to complete. This achievement has helped to place Canada on the global stage amongst other leading quantum countries.

Growth of the Canadian Quantum Sector:

Past government investments in fundamental research have positioned Canada as a global leader in quantum research. Today, Canada is at a critical juncture, and it is time to translate research and development into commercialization successes.

In the 2021 budget, the Government of Canada committed $360MM over seven years in support of its National Quantum Strategy (NQS). Xanadu welcomes the release of the NQS. We also appreciate the Government's commitment to seek new investments and program initiatives that will help further the broad policy objectives detailed under the NQS. Although the NQS is a helpful and promising outline to guide the Government's approach, clear and focused commitments are needed to fully realise the strategy's aims. Against a rapidly expanding quantum sector and increasing global competition, any delayed action by the Canadian Government will make it easier for entrepreneurs, experts, and our most innovative companies to be lured out of the country, undermining the government's investment in R&D, thereby losing out on the commercialization potential of these efforts.

To mitigate this risk, sector specific initiatives are needed to support the commercialization of quantum IP. It is for this reason we respectfully request the Standing Committee on Finance to detail and implement recommendations that will directly support the commercialization of quantum in Canada, while creating jobs and strengthening our economy. We have outlined below two targeted strategic initiatives that align with the specific goals of the NQS that would directly support the commercialization of the quantum sector in Canada.

Priority Recommendations:

- **<u>Recommendation 1:</u> In support of the commercialization of Canada's quantum IP, we strongly recommend Innovation, Science & Economic Development Canada (ISED) to engage with key stakeholders to establish a Canada Quantum Computing Centre, as the House Finance Committee recommended in 2021.**

    - **Issue:** Canada needs to put building blocks in place to properly commercialize its quantum IP. Those building blocks include, among other things, investments, research, quantum talent initiatives and a mechanism to foster inventive collaboration among those elements.
    - Canada's National Quantum Strategy addresses basic research and allocates small amounts of funding through existing programs, to support individual projects or startups. To fully realise Canada's quantum potential it is critical that the Federal Government focus these investments and create a research and commercial hub with critical mass.
    - By investing in a Canada Quantum Data Centre, through a set series of staged investments, the Federal Government would be creating and securing hundreds of new jobs and strengthening a talent pipeline for the future. The Centre – the first major hub of its kind in the world – would dramatically boost training for quantum computing research, operations, and maintenance.
    - Building this centre in Canada will provide access to Canadian quantum computers for Canadian academics, startups, large enterprises, and government users.
    - The centre would directly facilitate greater public-private collaboration and training in support of quantum innovation, critical components to realize the potential of Canadian quantum R&D.
    - This investment will build on other major commitments from the Federal Government and be positioned as a key component to Canada's National Quantum Strategy announced in January 2023.

    - **Background:** A Canada Quantum Data Centre would be a ground-breaking partnership between industry, academia, government, aimed at promoting and supporting Canada's standing in the rapidly developing field of quantum computing. It would be a truly made-in-Canada approach to building Canada's quantum ecosystem and greatly assist with future commercialization of cutting-edge technologies.
    - The initiative follows closely with the House Finance Committee's 2021 Pre-Budget recommendation to dedicate financial support to the establishment of a quantum computing research institute in the Toronto area, to build upon existing quantum research expertise in the city.
    - With the Centre's strategic position in Toronto, it will be perfectly suited to develop the Canadian quantum ecosystem and to partner with academia from across Canada, Canadian industry leaders and Federal and Provincial Governments. Toronto has become the centre for leading edge research, investment and commercialization of quantum computing and a growing attractor for global talent and high-tech job creation and is an ideal location for the quantum computing centre.

- The Canada Quantum Data Centre will embrace partners from the entire innovation ecosystem to offer access to the full Canadian quantum community and ensure the best chance for success. The Centre will be available to university and college students and researchers right across Canada and other academic organisations, including the Quantum Algorithms Institute, the Institute for Quantum Computing (IQC), and the Perimeter Institute. Potential Government partners include ISED, the National Research Council of Canada (NRC), Digital Research Alliance of Canada, all Departments and Agencies concerned with cyber security, the Canadian Space Agency (CSA), Bank of Canada, and many more.
- A comparable initiative in Europe provides a realistic benchmark for Canada. In 2022, the German government facilitated several contracts through the German Aerospace Centre Quantum Computing Initiative providing over €740 million in assistance. 80% of this funding has been allocated to R&D contracts for German companies to help develop quantum technology. So far the German government program has allocated €280 million to procurement of quantum computers from domestic companies.

- **Recommendation:** In support of the commercialization of Canada's quantum IP, we recommend that ISED engage key stakeholders to formalise a Public-Private Partnership and establish a Canada Quantum Data Centre – the first major hub of its kind in the world. The Centre will secure hundreds of new jobs, affirm a talent pipeline, and create jobs through research, operation, and maintenance. Industry and academic partners are already committed to realise the Canada Quantum Computing Centre. Earlier discussions with the Federal Government suggest receptivity; however, we encourage the Federal Government to officially join this initiative and dedicate funds to realise this public-private partnership.

- **<u>Recommendation 2:</u> To help facilitate the commercialization success of Canadian innovation and research, establish a nationally-coordinated funded program for quantum computing software education to create learning opportunities in quantum.**

  - **Issue:** In support of ongoing investments in research, talent and commercialization of quantum technologies, we recommend funding be directed to ISED to establish a funding program for Canadian universities across the country that would deliver specialised courses, learning opportunities and upskilling programs with Canadian companies through industry-academia partnerships. Specifically, programming can be applied nationally using the established open access Canadian platforms, such as Xanadu's PennyLane Cloud, the leading hardware-agnostic software toolkit for quantum computers, and other popular quantum software packages.
  - This funding program would ensure the creation of a strong talent pipeline across Canada and grow science and technology literacy amongst Canadians, including under-represented groups.

  - **Background:** Over the past several years, ISED and partner organisations have developed several government-based initiatives to help Canadians become more involved with STEM fields, providing important resources and materials.
  - Under a nationally-coordinated initiative geared to support quantum computing education and research, the government would be helping to accelerate and incubate the potential across Canadian universities, while building the talent pipeline to help facilitate successful commercialization and industry adoption of Canadian quantum innovations.
  - Supporting costs are needed for a small number of dedicated staff at each institution to help develop and deliver iterations of the courses in the first 2-3 years, until the

courses are established, and standard educational resources can be used to maintain them. Dedicated training and curricula development resources could be delivered through federal programs like NSERC or Mitacs, and provincial programs like OCI TalentEdge, or a combination of programs from both levels of government.

- Several Canadian universities are already working to coordinate a similar approach to quantum computing education and are looking for additional funding from governments to help execute this important initiative. To date, the University of Ottawa, University of Toronto, Queen's University and University of Calgary, are all working to deliver specialised courses in Quantum Computing programming using Xanadu's PennyLane to ensure a strong talent pipeline for Canadian businesses and institutions and to accelerate quantum application development and general adoption.
- Xanadu has already signed MOUs for cooperation with the above-mentioned universities, and we believe the current efforts could be greatly accelerated, and expanded to include more schools and students, with the application of a modest amount of funding and national coordination by ISED.

- **Recommendation:** We recommend the federal government dedicate funding to establish a nationally-coordinated program for quantum computing software education to create more learning opportunities in quantum, increase science and technology literacy across Canada and build a talent pipeline for generations of Canadians to come that will help facilitate the successful commercialization and industry adoption of Canadian quantum innovations.

On behalf of our company, I sincerely thank you for your consideration of these recommendations. Xanadu remains a committed partner to support the Government's work to bolster Canada's quantum sector.

Sincerely,

Christian Weedbrook, CEO
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