A Path to Global Leadership: High-Tech Exports and Innovation Spending as Canada's Competitive Edge

Introduction

Importance of Global Innovation

Global innovation is a cornerstone for economic growth, competitiveness, and resilience in a rapidly evolving global landscape. Nations worldwide are investing heavily in technological advancements, recognizing their transformative potential to drive economies forward, create high-value opportunities, and strengthen their capacity to respond to emerging challenges and intensifying competition. Innovation drives productivity, creates jobs, and empowers countries to take a leading role on the global stage. For Canada, the importance of innovation is not only economic but also strategic. To fully reap the benefits of innovation and position itself as a leader in the global landscape, Canada must address two key priorities: understanding how it measures against other nations in terms of innovation and identifying the critical factors that drive better innovation outcomes. This understanding is essential for shaping strategies that ensure long-term prosperity, inclusivity, and the agility to tackle global challenges with confidence.

Current State of Canada's Innovation Ecosystem

Canada's innovation ecosystem is currently shaped by the multi-year Innovation and Skills Plan, which was introduced to redefine the country's approach to fostering innovation and economic growth (see **Figure 1** for an overview). This plan focuses on several critical areas. It emphasizes the need to equip Canadians with lifelong skills in STEM, digital technologies, and innovation-related fields to ensure a robust and adaptable workforce. The plan also prioritizes building strong innovation ecosystems by fostering partnerships among research institutions, industries, and startups to bridge the gap between academic research and commercialization.

Moreover, the Innovation and Skills Plan supports small- and medium-sized enterprises (SMEs) and startups to scale up and compete globally by providing targeted investments and expanding access to export opportunities. It also simplifies access to government programs, making it easier for businesses to receive the support they need. However, while the plan has achieved notable progress, Canada's innovation ecosystem continues to face systemic challenges. These include insufficient collaboration between key stakeholders, gaps in translating research into commercially viable products, and declining investments in fundamental research and development (R&D).

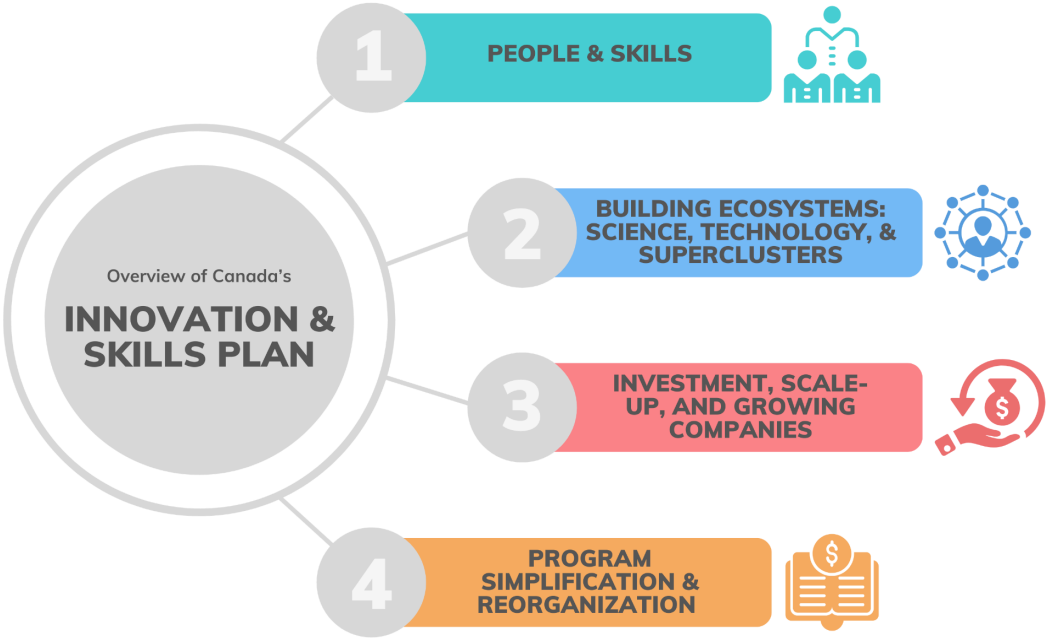

Figure 1. An Overview of Canada's Innovation and Skills Plan

Challenges and Need for Enhanced Strategies

Despite the progress achieved under the Innovation and Skills Plan, significant challenges remain in positioning Canada as a global leader in innovation. While the plan has made strides in fostering collaboration, supporting businesses, and enhancing skills development, gaps in effectively translating innovation into global economic success persist. For instance, scaling up innovative businesses to compete internationally remains a challenge, as does ensuring that investments in innovation have the necessary reach and impact to drive sustained growth. Furthermore, the rapid evolution of transformative technologies, such as generative AI models, underscores the urgency for Canada to adopt a more agile and forward-looking approach. Addressing these challenges is essential to strengthen Canada's ability to commercialize its research, compete in high-growth global markets, and build a resilient innovation ecosystem.

Project Goals

This report seeks to develop a data-driven approach to evaluate Canada's standing in innovation relative to other leading nations and to identify specific factors that contribute to successful innovation globally. By understanding which factors drive innovation and where Canada falls short, this analysis will enable the creation of targeted strategies to strengthen its innovation ecosystem. The project will use these insights to propose clear, actionable recommendations that address gaps in Canada's current approach and improve its competitiveness on the global stage.

Data Search

Data Sources

To build a reliable dataset for our analysis, we began by identifying trusted sources that offer comprehensive innovation and economic metrics. These included government publications, reports from global think tanks, and industry analyses. Our focus was on ensuring that each source provided standardized and comparable data across countries such as Canada, the United States, Switzerland, and South Korea. By leveraging these well-regarded sources, we prioritized data integrity and accuracy, ensuring that our findings would be robust and credible.

Data Collection

The data collection process was designed to efficiently gather and process information while ensuring its relevance and integrity. We utilized a variety of country-specific and global PDF reports containing innovation and economic metrics to ensure our dataset included reliable country-level feature values, while addressing potential gaps in coverage or granularity. These structured reports were converted from PDFs into text files using automated tools, preserving their organization and enabling us to quickly extract key metrics. To complement these quantitative sources, we also incorporated qualitative insights from alternative formats, such as YouTube videos, which offered a more nuanced view of innovation landscapes across countries. These videos were transcribed and integrated into the dataset, further enriching our understanding of global trends.

By combining structured data with qualitative insights, we created a comprehensive dataset that captures global innovation trends. This approach ensures robust coverage and allows us to derive meaningful insights about Canada's innovation performance relative to other countries.

Innovation Score & Features

In order to compare the countries on a consistent scale, our team utilized the innovation scores from the Global Innovation Index 2024, an annual report published by the World Intellectual Property Organization. This report evaluates the innovation ecosystem performance of 133 economies, offering a standardized measure that reflects both input factors, such as R&D spending and education, and output factors, such as knowledge creation and technological impact. By using this comprehensive index, we ensured that our comparisons were grounded in reliable and globally recognized metrics, capturing the most recent trends in innovation. This index not only provides a consistent framework for evaluating countries but also reveals Canada's position relative to its peers. As shown in **Figure 2**, Canada's innovation score ranks near the middle of the selected countries, behind leaders like Switzerland and Sweden, but ahead of countries such as Vietnam and India. This highlights Canada's strong foundation while underscoring opportunities to learn from top-performing nations.

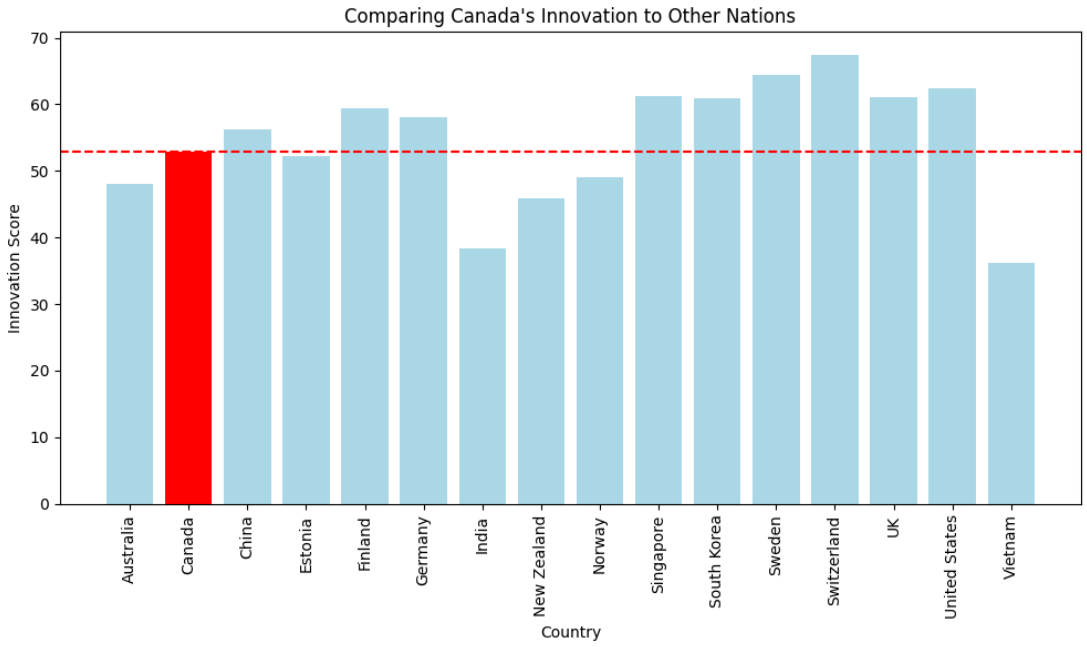

Figure 2. Canada's Innovation Score Compared to Peer Nations

To evaluate what drives innovation and economic performance, we identified 12 features that reflect key aspects of a country's innovation ecosystem. These features include metrics like R&D Expenditure (% of GDP) and the Number of Researchers per Capita, which provide measurable insights, alongside indicators like Public-Private Collaboration and the Number of Unicorn Startups, which capture the dynamic forces of innovation. By combining quantitative and qualitative measures, we aimed to create a balanced and comprehensive view of global innovation trends.

Identifying Global Innovation Leaders and Comparators

To ensure our analysis was both comprehensive and targeted, our team carefully selected countries based on factors relevant to innovation, ensuring we could draw meaningful comparisons and insights.

We began with countries that share similarities with Canada. Economic peers such as Australia, Germany, and the United Kingdom offer realistic benchmarks, given their reliance on natural resources and efforts to diversify their economies. These comparisons allowed us to evaluate adaptable strategies for shared challenges. Similarly, we included countries like Finland, Norway, and New Zealand, which face geographic and demographic challenges similar to Canada, such as small populations and resource-driven economies. These examples provided valuable insights into how focused investments can overcome structural limitations.

Beyond comparable nations, we turned to global leaders and innovators. Top-performing countries like Switzerland, South Korea, and Sweden have consistently excelled in innovation due to their strong academia-industry collaborations, high R&D intensity, and technology-driven economies.

Studying their strategies highlighted best practices for fostering thriving innovation ecosystems. We also examined emerging economies like China, India, and Vietnam, which demonstrate how targeted investments in R&D, startups, and digital transformation can accelerate growth. Finally, policy outliers like Singapore and Estonia showcased bold, creative approaches—such as Singapore's government-driven focus and Estonia's digital leadership—that could inspire transformative ideas.

By selecting countries through this multi-faceted lens, we aimed to strike a balance between learning from global leaders, understanding comparable challenges, and exploring creative solutions. This selection process laid the foundation for our team's analysis, ensuring that the data we collected would be relevant and actionable for shaping Canada's innovation strategy.

Analysis

To better understand Canada's innovation position and develop actionable strategies for improvement, we conducted a structured analysis of the data to uncover patterns, identify key drivers of innovation, and craft recommendations tailored to Canada's unique context.

Building a Predictive Model for Innovation

We began by creating a model designed to predict a country's innovation performance based on a range of features, such as venture capital investments, R&D expenditure, and education quality. This approach enabled us to identify and quantify the relationships between these factors and the overall innovation score. By prioritizing clarity and interpretability in the model's design, we ensured that the results would be both accessible and actionable for decision-making. The model demonstrated reasonable accuracy, predicting innovation scores with an average difference of only 0.8 points, indicating its ability to closely align with real-world outcomes.

Simplifying the Complexity Through Visualization

With so many factors influencing innovation, understanding how Canada relates to other countries required simplifying the data into a more digestible form. To do this, we used an approach that condenses the dataset into just two or three dimensions, effectively creating a "map" of countries based on their innovation characteristics. While **Figure 3** presents the two-dimensional visualization for clarity, a three-dimensional version was also explored to validate the observed patterns and ensure consistency in the insights. These visualizations revealed how countries cluster based on innovation trends. Canada was most similar to countries like Australia and New Zealand, positioned close together in the plot. In contrast, Canada stood apart from countries like Vietnam and the United States, which were far removed in terms of innovation score trends. This insight highlights peer countries whose strategies might offer the most relevant lessons for Canada.

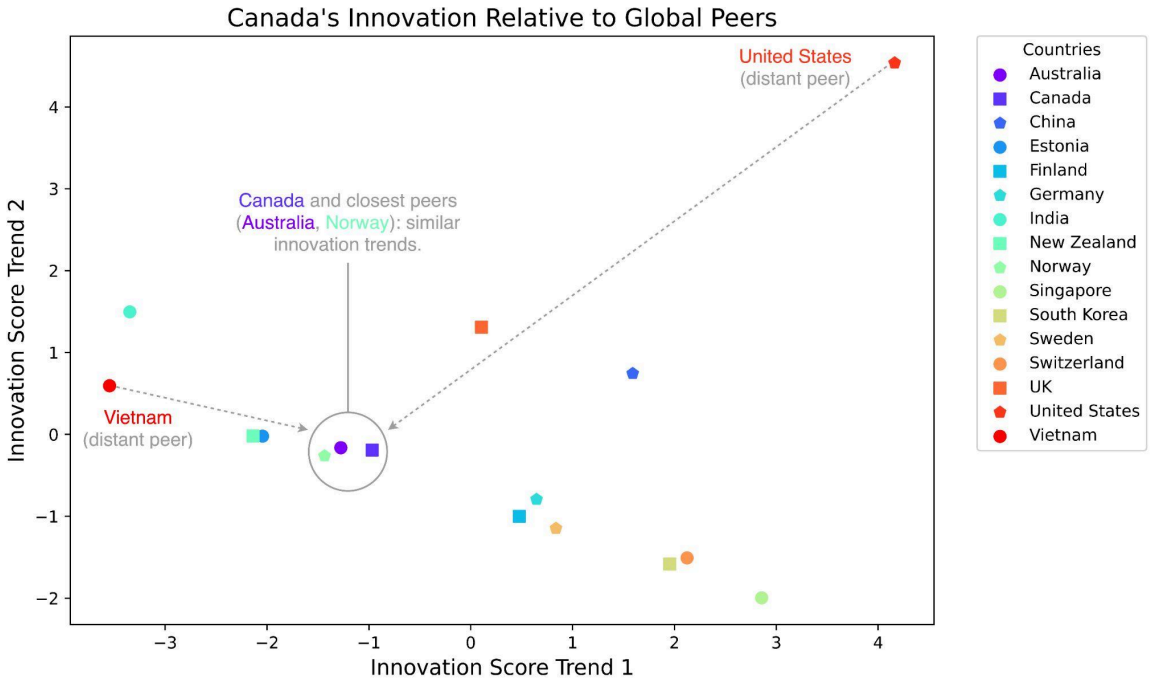

Figure 3. Comparing Canada's Innovation Ecosystem with Global Peers

Identifying the Most Influential Factors

Next, we analyzed which factors have the greatest impact on a country's innovation performance. By evaluating how each factor contributed to predicting innovation scores, we identified high-tech exports (percentage of exports attributed to advanced technology) and government spending on innovation as key areas where Canada had room to improve. The darker blue features in **Figure 4** represent the top three drivers of innovation performance, which we prioritized in our analysis. Interestingly, some factors traditionally associated with innovation, such as public-private collaboration and knowledge diffusion, were found to have minimal impact in this context and are shown in red to highlight their exclusion due to lower relevance. This allowed us to narrow our focus to the factors that matter most, ensuring that our recommendations would be both impactful and efficient.

Optimizing Canada's Innovation Score

Using this understanding, we simulated potential changes to Canada's innovation strategy to identify adjustments that would maximize its innovation score. The results indicated that Canada could achieve an approximate 30-point increase in its innovation score by reallocating resources strategically. Specifically, the analysis suggested reducing infrastructure readiness by one level (from 3 to 2) and marginally decreasing R&D spending (from 1.7% to 1.29% of GDP), with these resources redirected toward significantly increasing government spending on innovation (from 1.22% to 3.71%). Additionally, high-tech exports should be substantially increased (from approximately 20% to 30% of

total exports). Other factors, including researchers per capita, unicorn startups, education quality, and venture capital investments, were found to be stable and required minimal adjustment. These findings provide a clear data-driven foundation for optimizing Canada's innovation strategy.

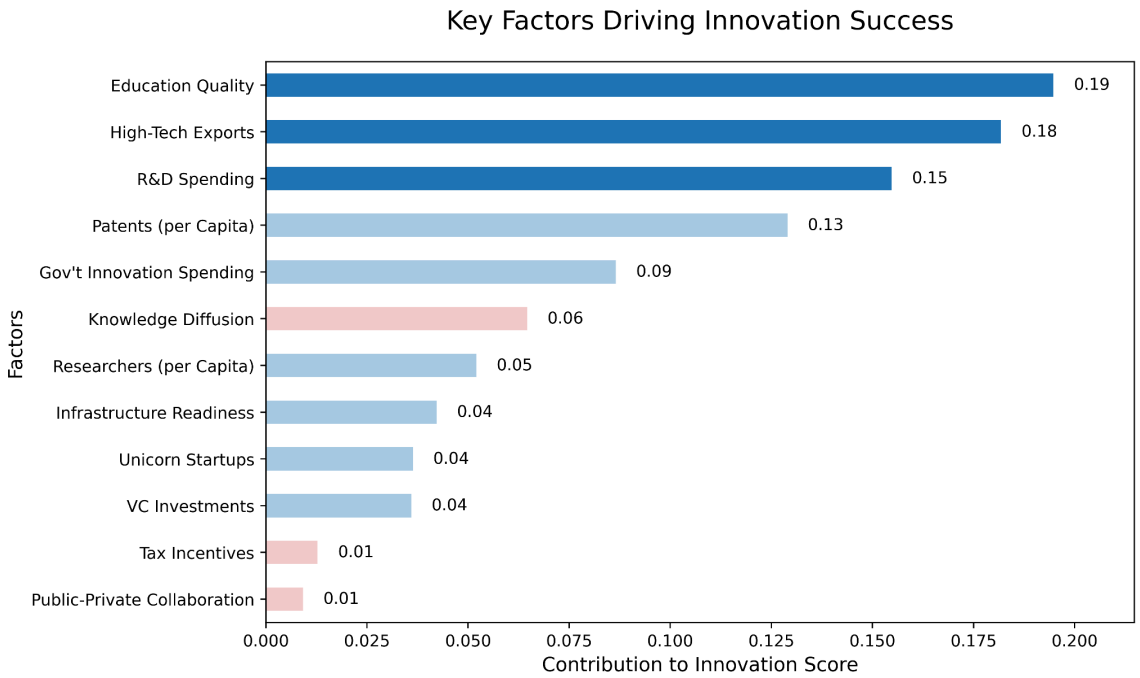

Figure 4. Contribution of Key Factors to Innovation Scores

This analysis not only highlighted where Canada stands today but also provided a roadmap for how to improve. By focusing on the factors that matter most and making strategic investments, Canada can position itself as a global leader in innovation while ensuring sustainable growth and resilience.

Discussion & Insights

Canada's current innovation strategy, while effective in certain areas, reveals key opportunities for improvement. The analysis highlighted two critical areas—high-tech exports and government spending on innovation—that require targeted action to unlock Canada's full potential. Despite strong fundamentals, such as a well-educated workforce and robust R&D capabilities, these areas lag behind global leaders and pose a bottleneck to Canada's progress toward becoming a top-tier innovation economy.

Canada's Leading Industries: Cleantech & Biotech

Among Canada's greatest strengths are its cleantech and biotech industries, both of which hold tremendous global demand and have positioned the country as a leader in innovation. Cleantech

innovations—products that reduce environmental impacts and promote resource conservation—have propelled Canada onto the world stage. Thirteen Canadian companies are ranked among the world's top 100 most innovative green energy firms, with advancements ranging from renewable energy solutions to carbon capture technologies and advanced recycling systems. Similarly, Canada's biotech and pharmaceutical sectors have long been at the forefront of healthcare breakthroughs, shaping global public health through innovations like the discovery of insulin, revolutionary AIDS treatments, and the Nobel Prize-winning hepatitis C vaccine.

Barriers to Growth

Yet, despite these remarkable achievements, both sectors face a troubling paradox: they contribute significantly to the country's trade deficit. In 2022, cleantech exports showed a trade deficit of $4.2 billion in environmental and clean technology (ECT) products—exceeding Canada's overall annual trade deficit. Similarly, Canada's life sciences sector, once a net exporter of pharmaceuticals, now struggles to meet domestic demand for drugs, making the country increasingly reliant on imports.

This trade deficit is a stark reminder of Canada's underperformance in global markets. In September 2024 alone, Canada's trade deficit reached $2.5 billion, underscoring its heavy reliance on imports over exports. Trade deficits of this magnitude not only constrain economic growth but also reflect missed opportunities to leverage high-value industries for export-driven success.

Compounding these challenges is Canada's lagging AI computing capacity, which is critical for supporting advancements in generative AI and other transformative technologies. Among G7 countries, Canada ranks the lowest in both total computing power and per capita performance. This shortfall places Canadian researchers and industries at a competitive disadvantage, hampering their ability to leverage AI for breakthroughs in fields like cleantech and biotech. Without substantial investments in supercomputing infrastructure and high-performance computing access, Canada risks falling further behind its global peers in AI-driven innovation and economic resilience.

These gaps present both a challenge and an opportunity. By addressing these weaknesses with targeted policies and investments, Canada has the potential to transform its trade deficit into a driver of economic growth, reclaiming its place as a global leader in cleantech and biotech exports. This dual focus on leveraging existing strengths and addressing critical weaknesses will be central to the strategies proposed in the next section.

Strategic Recommendations to the Government of Canada

To strengthen Canada's global competitiveness and innovation performance, our team proposes for the Canadian Government to adopt a unified strategy comprising two complementary pillars: boosting

high-tech exports and strengthening AI computing infrastructure. Together, these initiatives aim to address Canada's most pressing challenges—its trade deficit in high-value industries and its insufficient capacity to support cutting-edge technological advancements.

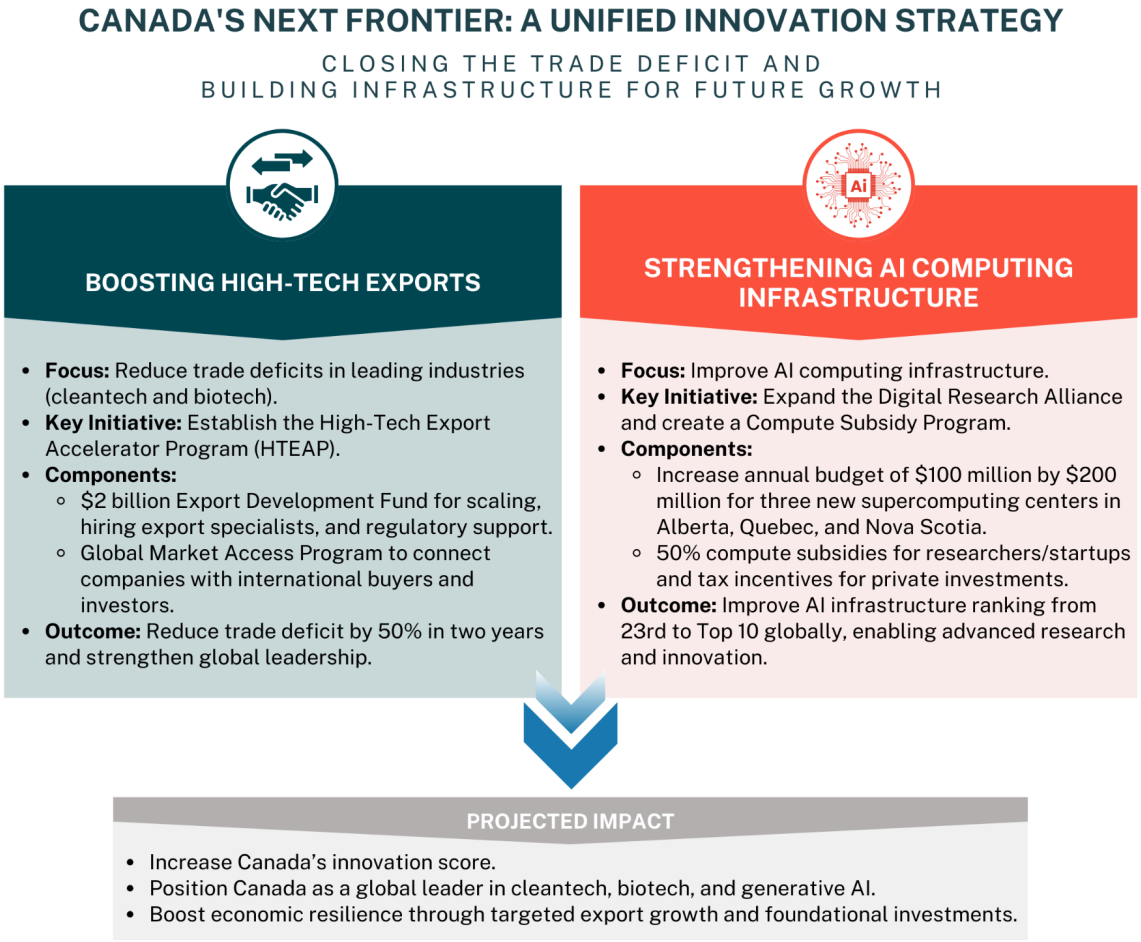

Figure 5. Overview of "Canada's Next Frontier" Strategy.

Pillar 1: Boosting High-Tech Exports

The first pillar focuses on reducing Canada's trade deficit by increasing high-tech exports, particularly in our leading industries, cleantech and biotech. We recommend the establishment of a High-Tech Export Accelerator Program (HTEAP), which will help export-ready companies scale their operations and expand into global markets. A core component of this program is an Export Development Fund, allocating $2 billion annually to provide grants and low-interest loans to cleantech and biotech firms. This investment is specifically designed to reverse Canada's $4.2 billion cleantech trade deficit within two years by supporting initiatives such as scaling manufacturing capacity, hiring export specialists, and meeting international regulatory standards. In addition, the program should include a Global Market

Access Program, developed in partnership with the Canadian Trade Commissioner Service. This initiative will establish a network of innovation trade hubs to connect Canadian companies with international buyers, investors, and strategic partners, addressing the current lack of dedicated export promotion for high-tech sectors. Together, these measures aim to reduce Canada's trade deficit while positioning it as a leader in global cleantech and biotech markets.

Pillar 2: Strengthening AI Computing Infrastructure

The second pillar addresses Canada's lagging AI computing capacity, vital for advancing cutting-edge technologies like generative AI and supporting breakthroughs in fields such as cleantech and biotech. To tackle this issue, we propose expanding the Digital Research Alliance of Canada by increasing its current annual budget of $100 million by $200 million. This funding will support the construction of three supercomputing centers in underrepresented provinces like Alberta, Quebec, and Nova Scotia, ensuring equitable access for researchers and startups across the country. In tandem, a Large-Scale Compute Subsidy Program should be introduced to offset the costs of high-performance compute services provided by companies like AWS and Microsoft Azure. Offering 50% subsidies for research institutions and startups, along with tax incentives for private sector investments in AI infrastructure, will enable Canadian innovators to overcome prohibitive costs and train advanced AI models. These investments will improve Canada's AI infrastructure ranking, currently 23rd among 61 countries, and establish it as a global leader in generative AI and advanced research.

Global PR Campaign: Canada—The Country of Innovation

To maximize the impact of these initiatives, we propose launching a global PR campaign, "Canada: The Country of Innovation." This campaign will highlight success stories from the High-Tech Export Accelerator Program, showcasing companies achieving export breakthroughs in cleantech and biotech. It will also emphasize Canada's expansion of AI computing infrastructure as a transformative step toward global leadership in advanced research. By leveraging social media, international events, and partnerships with Canadian ambassadors, the campaign will project a positive image of Canada as a destination for innovation and investment, attracting talent and fostering new opportunities.

Conclusion

Together, these two pillars tackle both immediate and long-term barriers to innovation by addressing Canada's trade deficit and infrastructure gaps. Boosting high-tech exports will generate economic growth and improve Canada's standing in global markets, while enhancing AI infrastructure ensures that Canadian innovators remain at the forefront of technological breakthroughs. By implementing this strategy, Canada can expect to see a significant improvement in its innovation score and international reputation, paving the way for sustained economic and innovation-driven success.