Replace, Reimagine, Recombine: Building an AI Nation

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April 2, 2025
This version: November 17, 2025

[1] I would like to thank Sanjeev Gill, Tom Gleave, Jimmy Lin, and Aaron Pereira for comments and feedback on the 3R Framework. I would also like to acknowledge guest editor Anindya Sen and two anonymous referees for their excellent comments, as well as the numerous policymakers and executives who shared their insights from the front lines.

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Abstract

Drawing on the historical examples of electricity and computing, this paper develops the 3R Framework - Replace, Reimagine, and Recombine - as a tool for understanding how general purpose technologies like AI reshape economies and society over time. The framework provides a map for navigating the coming AI revolution and offers practical tools and examples for seizing its opportunities. Crucially, the greatest value will come not from simply replacing existing technologies, but from reimagining processes, business models and entire industries around AI. To unlock these benefits and thrive in the intangibles economy, Canada must shift its AI paradigm from a focus on research and the pursuit of national AI industry champions, to cultivating a nation of AI adopters and reimaginers. The paper concludes by outlining the policies and programs needed to build such an AI Nation and draws lessons from the policies of peer countries.

Keywords: AI; adoption; general-purpose technology; productivity; Canada

1. Introduction

Canada is in a productivity crisis. Over the last 50 years, our GDP per hour worked has grown more slowly than that of any other G7 country (Figure 1). Recently, we have not only fallen behind in relative terms but also in absolute terms, with real GDP per capita down more than 3% over the last three years.[2] Our future prospects are no better: a recent OECD report predicts that over the next three decades, Canada will post the lowest economic growth of any of the 47 countries it examined (Guillemette and Turner, 2021). And all of this predates the onset of a trade war sparked by our closest trading partner.

But there is at least one source of hope in the form of artificial intelligence (AI). AI is a general purpose technology (GPT) that will radically change existing economic and social structures, offering Canada an opportunity to change our economic trajectory. Moreover, we are better placed than most to seize this opportunity. Much of the fundamental research in machine learning that paved the way for today's AI revolution took place on Canadian soil. Canada can lay claim to two of the three "godfathers of AI", Yoshua Bengio and Geoffrey Hinton, who together with the third godfather, Yann LeCun, shared the 2018 Turing Award for "conceptual and engineering breakthroughs that have made deep neural networks a critical component of computing[3]." In spite of recently losing some ground, we remain among the global research leaders (Maslej et al., 2024).

However, Canada has so far largely failed to translate its research strength into commercial success. The limited international data on AI adoption suggests that Canada lags not only peer countries but also many developing countries (Hartley et al., 2025; Lockhart, 2023). Driving mass adoption and commercial success are therefore urgent objectives.

AI, and in particular machine learning, will be transformative because it radically expands the set of tasks that can be augmented or automated entirely. Traditional computer algorithms could only automate routine and codifiable tasks, as they required programmers to specify the sequence of actions that needed to be performed for every possible eventuality. Tasks requiring tacit knowledge, from recognizing the content of an image to driving a car, had little hope of being performed by machines.

Machine learning changed that because it works on a fundamentally different paradigm. Instead of needing detailed instructions, supervised machine learning algorithms learn by observing (in the data) what agents do in different contexts and the outcomes associated with those actions. Effectively, they capture the tacit knowledge associated with the

[2] Real GDP per capita using chained 2017 dollars. Difference between 2022Q2 and 2025Q2. Statistics Canada Table 36-10-0706-01. August 29, 2025. https://doi.org/10.25318/3610070601-eng.
[3] Association for Computing Machinery. https://awards.acm.org/about/2018-turing. Accessed March 31, 2025.

actions of agents and store it in a model. For example, by observing the diagnoses made by doctors in different contexts, they can learn to diagnose.[4] Once this tacit knowledge is captured, it can either be used to empower individuals who don't themselves have that knowledge (allowing nurses to diagnose at the level of doctors) or to automate a task entirely (directly performing diagnoses).

Until recently, machine learning could best be thought of as a better prediction technology (Agrawal et al., 2018). It could better predict the content of an image, whether someone was going to default on a loan, or what movie someone might want to watch next. However, in November of 2022, with the launch of ChatGPT, we moved from the age of predictive AI into the age of generative AI. Suddenly, AI could generate text, images, music and even videos, vastly expanding the technology's capabilities. Yet ChatGPT's most transformative contribution wasn't technical, it was the democratization of AI. By allowing people to interact with AI in natural language, the technology moved from our research centres and the back office of our biggest firms to the fingertips of all Canadians.

We have arrived at this point thanks to exponential growth in computing power, mass digitization (which produced massive amounts of data), and advances in AI algorithms like the transformer architecture (Vaswani et al., 2017). Today, the key question is not so much how we got here but where we are going. We can gain insight into how the AI revolution is going to unfold by learning from the adoption path of previous general purpose technologies.

The next section examines past GPT technologies and synthesises learnings into a framework that can guide our thinking on how the coming AI revolution will unfold, the opportunities that it will bring, and the impacts that it might have on jobs and skills. Section 3 delves deeper into the first two phases of AI adoption, offering examples and tools that can help individuals, businesses, and policymakers seize its opportunities. Section 4 ties the framework into the broader discussion on the intangibles economy. Section 5 examines the AI policies and programs that Canada must put in place to seize the opportunities of AI, and compares them to the initiatives put forward in the UK, Singapore, and Taiwan. Section 6 concludes.

[4] While some diagnosing capability is often available "out of the box", a large language model would normally also need to be fine-tuned for medical diagnosis and require reinforcement learning from expert feedback. Moreover, to operate effectively the model would also require context data for the given case. Some of the context information might be available (e.g. blood pressure, temperature, blood test result, family history, etc.) but other might not (breathing pattern, energy levels, etc.).

2. General Purpose Technologies and the 3R Framework

The steam engine, electricity, and information and communications technology (including computers) are all examples of GPTs. These technologies are characterized by three core characteristics: they are pervasive (impacting not just one sector but many, or even all), subject to ongoing improvements (they are not fixed but rather improving over time), and subject to innovation complementarities (there is a strategic interplay between the technology and other technologies that are developing alongside them) (Bresnahan and Trajtenberg, 1995). A good example of the latter is the interplay between computers and software, where investments in one make the other technology more valuable.

Due to these characteristics, GPTs tend to be transformational. However, these same characteristics also imply that it can take decades to fully realize their impact. In particular, due to innovation complementarities, in a decentralized economy there can be underinvestment both by ongoing developers of the GPT and by developers of its applications, because neither internalizes the benefits that their investment brings to the other. Moreover, information asymmetries can also slow the rate of progress. For example, software developers sometimes needed to wait for the specifications of the latest Intel chip, and Intel might have waited to observe the direction of software development before designing its next generation chip.

However, the most important lesson from past GPTs is that they follow a common adoption trajectory, unfolding in three distinct phases as captured in the following 3R Framework (see Figure 2). In the first phase, *Replace*, the new technology displaces the old technology (which is sometimes humans doing things manually) within existing processes. But crucially, the overall processes themselves do not change, nor do the business structures or business models.

It is not until the *Reimagine* phase, often decades later, that inventors and entrepreneurs begin to grasp the true potential of the technology and start to reimagine entirely new processes, structures, and business models around it. This tends to be the disruptive phase, where entire industries are transformed through the process of creative destruction (Schumpeter, 1942).

In the final stage, *Recombine*, the GPT fuses with other technologies to create entirely new ones, and if one of those combinations is itself a GPT, the cycle begins anew.[5]

[5] Scholars have long argued that innovation is the result of the recombination of existing ideas (Usher, 1927; Schumpeter, 1934; Hadamard, 1949). In his paper titled “Recombinant Growth”, Weitzman (1998) models technological progress as the result of endlessly combining existing ideas. Most new technologies have

While the full adoption path is captured by the sequence of all three phases, this paper primarily focuses on the first two, *Replace* and *Reimagine*, because they are the most immediately actionable phases. The direction of *Recombine* is ex-ante highly uncertain and its opportunities much further in the future.

To illustrate the framework, it is instructive to examine earlier GPTs, including electricity and computers.

2.1 Electricity

Thomas Edison developed the carbon filament lamp, the first practical light bulb, in 1879. Three years later, he established generating stations in New York City and London. Yet as documented by the economic historian Paul David (1989, 1990), it took much longer for electricity to be widely adopted as the primary source of power in factories. Even by the late 1890s, factories remained largely powered by the steam engine.

Because the steam engine had to be run at scale, factories typically had a single power source, and any workstations requiring power had to be connected to it through a line shaft. This forced a vertical layout to the factory so that all workstations could be located near the power source.

By the turn of the century, we entered the *Replace* phase of electricity. Electric motors were more efficient, cleaner, safer and easier to operate than steam engines. Factories therefore began replacing the steam engine with a single large electric motor. But crucially, the factory layout remained the same and as a result, productivity gains were relatively minor.

It was not until some two decades later that innovators like Henry Ford began to *reimagine* factories around the electric motor. Unlike the steam engine, electric motors did not need to be run at scale. Every workstation could thus have its own electric motor, obviating the need to be connected to a central power source via a line shaft. Factories could therefore be organized more logically so that the outputs from one station became the inputs of the next, giving rise to the modern assembly plant.

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indeed emerged as the recombination of previously existing ones. The printing press was the combination of the screw press, movable metal type, and oil-based ink. The telephone recombined the telegraph, the microphone, and the speaker.

Among the most famous of these is the Ford Model T Assembly Line from 1913. The number of labour hours per car produced by Ford decreased about sixfold between 1909 and 1915, from around 400 to approximately 65 (Wilson and McKinlay, 2010).

According to David (1990), "factory electrification did not reach full fruition in its technical development nor have an impact on productivity growth in manufacturing" until the early 1920s, four decades after the first power generating plants. As Figure 3 shows, at that time only about half of mechanical drive capacity in U.S. manufacturing had been electrified, and it would take two more decades to reach near full penetration (David, 1989).

There were many reasons for the slow adoption. As previously discussed, GPTs tend to develop more slowly than expected because they depend on the development of complementary technologies. Human creativity and ingenuity are also a limiting factor as people struggle to reimagine existing processes, structures and business models. Beyond the need for such innovation, David (1990) also lists the need for complementary investments in infrastructure, management practices and human capital as reasons for the delayed impact of electricity.

For completeness, even if rather obvious, it is worth noting that electricity eventually combined with many other technologies, such as advanced materials to create the transistor, semiconductors, and computers. The latter, being itself a GPT, also followed a path of adoption along the three phases.

2.2 Computers

In 1987, Robert Solow famously quipped that "you can see the computer age everywhere but in the productivity statistics." This was in reference to the "productivity paradox," that despite large investments in computers and information technology over the 1970s and 1980s, productivity growth was the lowest in decades. Indeed, nearly twenty years after Intel introduced the 1043-byte memory chip (in 1969) and the silicon microprocessor (in 1970), widespread adoption remained elusive.

Initially, computers merely replaced earlier technologies within existing processes. The term "computer" used to refer to individuals whose job was to perform calculations - they were among the first to be replaced by electronic computers. Spreadsheets replaced accounting books, and by speeding up many accounting tasks, they also displaced many bookkeepers. Word processors replaced typewriters, and in the process displaced many

typists. Also displaced were typesetters, filers, bank tellers (many of whom saw their duties redirected), and draftspeople, among others.

Computers and information technology also allowed easier communications and greater control of organizations. This enabled executives to *reimagine* the structure of their organizations. Easier communication allowed firms to venture abroad. Greater control resulted in fewer middle managers and a flattening out of the organization. Expert systems reduced workers' cost of acquiring information, thus increasing their scope while also flattening organization structures (Garicano, 2000). In so doing, they challenged the long-standing idea, dating back to Adam Smith, that hyperspecialization was the key to process efficiency. For example, IBM Credit Corporation was able to reimagine its credit issuance process from one involving multiple specialists to one handled by a single deal structurer, supported by expert software that helped determine creditworthiness, loan terms, and rates. By eliminating handoffs, the average turnaround time fell from six days to four hours, and the number of deals processed increased by two orders of magnitude (Hammer and Champy, 1993).

Ultimately, computers also allowed new business strategies like customer relationship management. The collection, storage, and analysis of large amounts of data allowed firms to better understand, respond to, and even anticipate customer needs — ultimately driving profitability and loyalty.

As with electricity, computers initially *replaced* earlier technologies. But over time, executives and entrepreneurs began to *reimagine* processes, structures and business models. Eventually, computers also *recombined* with other technologies to create the Internet, smartphones, and AI.

3. The AI Revolution

The 3R Framework offers a roadmap for navigating the AI revolution by breaking down its adoption into three clear phases: *Replace*, *Reimagine*, and *Recombine*. This framework can help individuals, businesses, and governments make sense of where we are and where we are headed. It also serves to democratize the conversation: by breaking the AI revolution into concrete phases, it allows more people to see themselves as active participants in shaping the future, rather than passive observers. It provides a shared language for discussing change, and a structure for planning and coordination. Having a framework helps orient actors in a space that otherwise feels overwhelming, allowing for more decisive action and more targeted investments.

For policymakers, the framework clarifies the kinds of actions that are appropriate at each stage and can thus help develop regulatory policy that fosters responsible AI without stifling innovation. It can also help plan responses to potential job losses.

The impact that AI is likely to have on jobs during the *Replace* phase is somewhat predictable. By mapping current AI capabilities to existing occupational tasks, it is possible to estimate how many workers overall, and which occupations in particular, are going to be impacted (Felten et al., 2021; Eloundou et al., 2024; Cazzaniga et al., 2024; Mehdi and Morissette, 2024). However, these should be seen as predictions of AI's impact during the *Replace* phase. Predictions become more difficult for the *Reimagine* and *Recombine* phases, as entire industries will be disrupted, necessitating more adaptive wait-and-see policy approaches.

But the framework is more than just a map — it is a tool for fostering ambition and creativity. It makes clear that the real economic and societal benefits of AI will not come from using it to do old things faster or cheaper, but from reimagining entirely new ways of doing things. This shift in mindset is critical if we are to unlock the full potential of AI.

In the next subsections we discuss how organizations can seize the opportunities, focusing on the two most immediate phases of adoption. Later, in Section 5, we discuss how government policies and programs can help set the stage for an AI revolution.

3.1 AI Replace

In the *Replace* phase, AI will displace older technologies (including people doing things manually) to increase the efficiency of existing processes. This phase is about leveraging AI to do existing things better: cut costs, reduce risks, increase speed, expand volume, or improve quality.

The process for seizing these opportunities is conceptually straightforward and can be broken down into four main steps:

1. Break down processes and workflows into tasks
2. Identify the tasks that are fundamentally things that AI does well
3. Compute the return on investment (ROI) for automating each task
4. Starting at the top of the ROI list, replace the older technology with AI

A central challenge, therefore, is to understand what AI does well. Until November 2022, that could be summarized as any task requiring prediction. For example, predicting whether a transaction is fraudulent, what other movies someone might want to watch,

whether a molecule will have the desired clinical effects, or the trajectory of a nearby vehicle. But in the age of generative AI, the set of tasks that AI can accomplish has expanded greatly.

Table 1 presents a list and categorization of tasks that generative AI can accomplish. The table builds on early work by Korinek (2023) and a more recent survey by Bick et al. (2024). This list is updated and augmented based on my interactions with executives from dozens of companies at different stages of their AI journey. The high-level categories include writing, ideation, background research, coding, data analysis, math, advising, innovation, reporting, accounting, image generation, video generation, and music generation. It should be noted that while this list provides a useful starting point, it is by no means exhaustive. Moreover, the breadth of tasks that generative AI can perform continues to expand, so that this table may quickly become outdated.

Three important additional notes to the four-step process for engaging in AI *Replace* pertain to automation versus augmentation, the locus of AI adoption, and objectives other than ROI. First, when the legacy technology consists of people performing a task manually, AI may often not so much replace humans as empower them to perform the task more efficiently. For example, AI may not replace a journalist entirely in the writing of articles because the individual is still needed to interpret information and to pitch the story. But AI will speed up the writing task. However, while the distinction between automation and augmentation is important, the end result may be similar. In the example of the journalist, if AI empowers the individual to produce twice as many articles in an hour of work, their employer may only need half as many journalists[6].

Second, much of the AI *Replace* may unfold not in a top-down fashion but from the bottom up. As discussed, AI has become a fundamentally democratic technology. Canadians are experimenting with the technology and using it to better perform their jobs often without the blessing of their superiors. Some of the technology will thus diffuse within businesses even without a directive from, or the support of, senior executives. Viewed this way, the responsibility of executives is to provide the guardrails so that employees can safely experiment with the technology, and to remove any stigma around its use so that individuals share experimentation learnings with colleagues. As highlighted by Mollick (2024), among others, experimentation is crucial to get the most from generative AI,

[6] In practice whether augmentation results in job losses will vary by sector. As productivity increases, demand for the now cheaper service will also increase. Whether the effect on jobs of this increased demand will offset or even outpace the impact of increased labour productivity will depend on factors like the price elasticity of demand. In areas like programming the lower costs could drive a much-increased demand for software and thus a net increase in the number of software developers.

because outside of a core set of capabilities, it is not always clear which tasks AI can perform well and which it cannot.

Third, while the four-step process above describes the goal in terms of achieving a high ROI, it is clear that organizations may prioritize other objectives such as minimizing risk, ease of implementation, speed of implementation, impact on workers, or many other factors. In practice, the organization will want to prioritize the initiatives that most satisfy a combination of factors.

Canadians must urgently begin to engage in the *Replace* phase of AI. As captured by a growing body of literature, the benefits of doing so can be significant. In a pre-registered online experiment, Noy and Zhang (2023) document that access to ChatGPT decreases the time taken to complete a professional writing task by 40% and increases the quality of the output. In another online experiment, Peng et al. (2023) find that software developers with access to GitHub Copilot implemented an HTTP server in JavaScript 127% faster than those without it. In a separate experiment involving consultants from Boston Consulting Group performing realistic tasks, Dell'Acqua et al (2023) find that access to GPT-4 increases the number of tasks completed by 12%, speed by 25% and quality by 40%. In all three studies, the impacts are significantly larger among less skilled individuals, suggesting that generative AI can be a great equalizer.

Brynjolfsson et al. (2025) provide empirical evidence from the field. They study the staggered introduction of a generative AI-based conversational assistant at a Fortune 500 business software firm and track the performance of 5172 customer service agents. AI assistance increases the number of cases that agents resolve per hour by 15%. It also improves satisfaction among customers and agents, resulting in higher customer sentiment, fewer escalations to managers, and increased agent retention. As with other studies, less skilled and less experienced agents saw the biggest benefit from the AI assistant.[7]

Generative AI has also been shown to help with creative tasks. Doshi and Hauser (2024) study creative writing and find that writers who are given GPT-4-generated three-sentence starting ideas produce short stories that are more creative, better written, and more enjoyable. This is particularly true for less creative writers, to the point that differences in

[7] While this seems to be a general finding in the literature across a wide range of use cases, it is plausible that in some contexts AI could instead most benefit the highest skilled. This could happen if the effective use of an AI tool requires a high level of expertise. For example, if an AI coding tool requires the programmer to spend lots of time verifying AI generated code and this is something that more experienced coders do much better, the AI tool might mostly benefit the most skilled. More generally, AI will tend to automate only a subset of an occupation's tasks. If it primarily automates the tasks requiring the least expertise, AI could most benefit the most expert individuals in that occupation.

output quality between less and more creative writers are effectively erased with the help of GPT-4. However, they also find that AI-enabled stories are more similar to one another than stories written by humans alone. Porter and Machery (2024) find that AI-generated poetry is indistinguishable from human-written poetry and is, in fact, rated more highly in qualities such as rhythm and beauty.

Girotra et al. (2023) find that GPT-4 is able to generate better consumer product ideas, as measured by purchase intent, than MBA students in a product design course. While GPT-4 ideas comprised exactly half of the total sample (the other half being student ideas), they accounted for 35 of the 40 ideas in the top decile. Dell'Acqua et al. (2025) conduct a field experiment with 776 professionals at Procter & Gamble and also find that AI enhances product innovation. In particular, they find that individuals working with AI matched the performance of teams without AI, suggesting that AI can replicate some of the benefits of human collaboration. Boussioux et al. (2024) compare human-crowdsourced sustainability-focused business ideas to those generated by individuals working with AI. While the human crowd solutions exhibit higher novelty, the human-AI solutions are more viable, more valuable, and of higher overall quality.

Other work has shown that AI outperforms medical students (Strong et al., 2023) and physicians (Ayers et al., 2023), and that a Tutor CoPilot improves student performance (Wang, 2024).

Together, these studies point to how AI can increase productivity, creativity and quality in the *Replace* phase. Numerous AI use cases already exist across a wide range of functions, including customer service, marketing, education, human resources, product development, research, accounting, and law.

It is clear that Canadian business, government and individuals must begin to embrace AI. The benefits that it will bring in the *Replace* phase alone are sizeable. But as with other GPTs, these will pale in comparison to what AI will offer as we begin to radically reimagine our world around it.

3.2 AI Reimagine

The AI *Reimagine* phase is about reinventing processes, organizational structures, business models and entire industries around AI. The potential benefits are commensurate with the scale of the challenge.

Reimagine is considerably more difficult than *Replace* because it requires not only the ability to see beyond what currently exists, but also a willingness to embark on radical

change. No single recipe exists, because the solution will look different in every sector and context. However, it is possible to both offer examples of *Reimagine* and lenses for identifying opportunities and fostering creativity.

Examples from the Internet Age

The most instructive examples of reimagining a business model come from our last major general purpose technology: the Internet. The canonical example is Amazon.

Amazon reimagined bookselling. They weren't the only ones to recognize the Internet's potential for the book business, Barnes & Noble did as well. Barnes & Noble used it for functions like managing inventory and helping customers locate books on shelves, but they remained in the *Replace* phase. Amazon, on the other hand, built its entire business around the Internet, creating an online platform for browsing and buying books (and eventually everything else) that offered lower costs, greater selection, direct marketing opportunities (recommendations), and a better customer experience (reviews, fast home delivery). It digitized the book-buying experience, driving massive economies of scale.

John Foley, then President of eCommerce at Barnes & Noble, understood that Amazon had reimagined the industry and that Barnes & Noble could never compete with Amazon's scale and lower cost. A business model built around the Internet would always beat a legacy model that merely used the Internet. Foley left Barnes & Noble and launched a company that would do to fitness what Amazon had done to him. He reimagined fitness around the Internet as the Co-Founder and CEO of Peloton.

There are many other examples of business models and industries being reimagined around the Internet. After reimagining bookselling and retail, Amazon went on to reimagine computer services. Amazon Web Services now contributes nearly 60% of the company's total earnings. Facebook reimagined human connections, Google reimagined access to information and advertising, Netflix reimagined entertainment, Airbnb temporary accommodations, and Uber personal transportation. With the exception of Netflix, who had the rare foresight to cannibalise its existing mail-based business and pivot to Internet delivery, all of these were start-ups created to seize the *Reimagine* opportunity of a new technology. Today, these are some of the biggest multinationals in the world.

Reimagine Lenses

Executives and entrepreneurs who want to create the Amazons and Facebooks of the AI age must reimagine entire industries. An important first step is to understand what AI

technology currently offers (prediction, in addition to the capabilities summarized in Table 1) and what additional capabilities it will soon offer (agents, outside tools, self-updating).

The most significant challenge involves using this knowledge to reimagine processes, structures and business models. Figure 4 presents five lenses through which to identify opportunities. These questions are by no means exhaustive and are meant to foster thinking and creativity.

The first lens, is to consider whether the previous technology imposed explicit or implicit constraints. The requirement of the steam engine to run at scale led to the implicit constraint that factories would have a single (or at most a few) on-site sources of power. When the electric motor replaced the steam engine, these constraints disappeared, but it took decades for entrepreneurs like Henry Ford to arrive at the modern assembly line: a reimagined factory floor that was free of those limitations. Tesla similarly reimagined automobiles by eschewing the constraints imposed by the internal combustion engine.

A second approach, particularly when trying to reimagine an existing process, is to focus on the end goal and ask whether it is possible to offer customers a better product or experience. If IBM Credit Corporation had focused only on increasing the efficiency of the existing process, they would have used computers to marginally improve each step (*Replace*-phase thinking). Instead, they asked how they could offer their customers a better and faster experience and reimagined the entire process from scratch. Facebook and Uber are other examples of companies that innovated to provide customers a better product or experience than was previously available.

The third approach is to consider whether AI and Information technologies can be leveraged to massively scale. When processes, services or products are digitized, they can be replicated at near-zero marginal cost. In addition, the data they generate can be processed in real time and used for learning and updating. This leads to massive economies of scale and a potential winner-takes-all scenario. In particular, acquiring new customers can lead to improved offerings, and in turn, further customer acquisitions. Amazon's reimagining of retail around the Internet is an example of digitizing and automating as much of the business model as possible to drive massive economies of scale. The company is relentless in this pursuit and is therefore exploring the automation of its biggest bottleneck, package delivery, using autonomous drones. Netflix is another example of a company that digitized its business (moving from physical delivery of movies to Internet delivery) to drive massive economies of scale. Airbnb similarly digitized the offering, searching, and booking of accommodations.

A fourth lens is to ask where tacit knowledge is crucial. As discussed in the introduction, AI can be thought of as a technology that captures tacit knowledge, which can then be used to automate tasks that rely on it. Two sectors of the economy that have barely changed in decades, if not centuries, are education and healthcare. These services rely on the highly specialized tacit knowledge embodied in teachers and professors on the one hand, and doctors on the other. AI will allow much of the work performed by these professionals to be automated. Below, I discuss examples of how capturing tacit knowledge and automating its use can lead to the reimagining of higher education and healthcare delivery.

The last lens is related to the fourth and asks what tasks have become orders of magnitude cheaper, or even feasible, with AI. Once such tasks are identified, processes or business models can be reimagined to make abundant use of those tasks. Below, I also share examples of reimagining the hiring function and the grocery business around newly cheap and newly feasible tasks.

Examples of AI Reimagine

It is difficult to predict the future with full-fledged cases of how AI will be used to reimagine. However, I offer some guiding examples of how we might reimagine the hiring function, the grocery business, higher education, and primary healthcare.

Hiring function: Once we have AI agents that can collect and evaluate large amounts of data on potential hires and write personalized messages at low cost, we will be able to turn the hiring process on its head. Instead of posting a job ad and sifting through resumes and cover letters (all things that AI can help with, but that remain squarely in the *Replace* realm), we could tell an AI agent the set of skills we are seeking. The agent would then search the Internet or LinkedIn, identify top targets, write a customized job description that would get the most from that employee, and send a personalized invitation to interview. Effectively, this would be the equivalent of performing executive searches for every employee in the organization, and it would be made possible because AI lowered the cost of such searches by orders of magnitude.

Grocery business: If AI prediction, supercharged by the Internet of things, improved to the point where grocers could accurately forecast when customers would need milk, bread, or other goods, they could trade the majority of their brick-and-mortar stores for trucks that drive through neighbourhoods, delivering products if and when customers need them. This is an example of AI making the task of accurate prediction possible.

Higher education: In an influential paper, Bloom (1984) highlights the profound impact that individualized tutoring has on student performance (the average tutored student scored

above 98% of the non-tutored students). However, he concludes that one-on-one tutoring "is too costly for most societies to bear on a large scale." The paper's central challenge, known as the "2 Sigma problem", is therefore to find scalable instructional methods that can achieve this level of effectiveness.

AI tutors promise exactly this. Upon admission to university, every student would be given an AI assistant that would be by their side throughout their educational journey and beyond. The AI would be fine-tuned on the material from the courses the student takes (capturing the tacit knowledge of professors). To help the student in a particular course, the tutor would evaluate the student's mastery of the content (either formally through tests or informally in a chat) and, if required, implement corrective procedures. The tutor would also be personalized to the student, learning over time how the student prefers to interact, how they learn best, how to provide encouragement, and how and when to offer emotional support. The tutor would be a loyal assistant and friend to the student during their education and would subsequently follow them to support their career.

Future universities could entirely re-imagine their activities around this AI tutor. Instead of providing lectures, professors would instruct the tutors on what to teach. The AI tutor would also change how students navigate the university experience, how they seek jobs and how they stay connected to their alma mater after graduation.

Primary healthcare: An AI chatbot model that captured the tacit knowledge of doctors could serve as the gatekeeper to our healthcare system. Patients would explain their symptoms and medical history, as well as provide any relevant diagnostic results (temperature, blood pressure, heart rate, etc.), and the AI would decide on the appropriate next steps: a prescription sent directly to the pharmacy for low-risk ailments, a referral to a family doctor for more complex cases, a visit to the emergency department for urgent cases, or a referral to other healthcare professionals such as specialists, counsellors, or physiotherapists. A less radical version of this model would involve a nurse, empowered with the tacit knowledge captured by the AI, to act as the gatekeeper with a human face. A reimagined system like this, by reserving family doctors for where they are truly needed, could extend access to primary care to the 6.5 million Canadians who don't currently have it.

3.3 AI Recombine

Recombine is further beyond the horizon and therefore less the focus of this paper. It is where we begin to reimagine the world not around the current technology, but around a future technology that is the combination of many. In *Recombine*, we harness the

synergies between AI and other current and emerging technologies to radically expand what is possible.

One combination that seems pre-destined is the emergence of collaborative robots ("cobots"), that integrate flexible robotics, AI and 6G connectivity. These cobots will have the strength and manual dexterity to accomplish most physical tasks, be intelligent enough to navigate everyday settings and solve complex cognitive problems, and have access to the full knowledge of the Internet in real time.

Other technologies that are likely to emerge include ultra-personalized gene therapy (combining AI, CRISPR, and genomic sequencing), thought-based control systems (combining AI with brain implants), and intelligent self-governing decentralized autonomous organizations (combining AI with smart contracts and distributed ledgers).

4 Reimagine and the Intangible Economy

As documented by Lev (2001) and Haskel and Westlake (2017), among others, intangible assets (patents, trademarks, copyrights, brands, software, data, organizational capital, human capital, etc.) are playing an increasingly important role in advanced economies and are driving much of the productivity gains. While this is also true in Canada, their contribution has been lower (Baldwin et al., 2012; Allen et al., 2025).

Numerous commentators and experts have argued that to compete in the new economy, Canada must, among other things, accumulate intangible assets (Speer and Asselin, 2019; Balsillie, 2024; Fitz-Gerald and Samson, 2025). Such arguments are only partially correct in that they can confuse correlation with causality. Amazon and Facebook became world-leading companies not by accumulating intangible assets, but by reimagining an industry around a new technology. They then accumulated intangible assets both as a byproduct of their operations (e.g. data, brand) and by investing in the development of further intangible assets to support their business model (e.g. software, algorithms, patents, data).

Figure 5 shows the market capitalization and book value of publicly listed companies headquartered in Canada or the United States[8] at the end of fiscal year 2023. The companies with the biggest difference between market capitalization and book value, a rough measure of intangible assets, are, in order: Apple, Microsoft, Nvidia, Alphabet, Amazon, Meta, and Tesla.

[8] Data was obtained from Compustat North America for the fiscal year 2023.

Apple reimagined the mobile industry by turning phones into pocket computers and entertainment devices. Microsoft reimagined personal computing by developing a graphical user interface that made computers accessible to everyone. Nvidia perhaps did not directly reimagine an industry, but its products were instrumental in transforming first the gaming industry (allowing cinematic 3D experiences) and more recently the AI industry, through an ecosystem that includes hardware, software and platforms. Tesla reimagined the automotive industry both by reinventing cars around electric power (multiple electric motors, no transmission, skateboard chassis, regenerative breaking), and by creating a software-first vehicle (smart, updatable, interactive). Alphabet, Amazon and Meta also reimagined entire industries, as already discussed.

If the companies with the most intangible assets are those that successfully reimagined an entire industry, Canada is not lagging due to a lack of intangible asset accumulation, but rather because we are failing to reimagine. By our measure, the Canadian company with the most intangible assets is Shopify, which reimagined retail by building a plug-and-play ecommerce platform that enabled anyone to sell online. But as seen in Figure 5, Shopify is the exception, not the rule. Canadian companies, by and large, have low ratios of market capitalization to book value. Indeed, while the U.S. companies in our sample have, on average, a market cap that is 15.6 times greater than their book value, for Canadian companies on average the market cap is less than the book value (ratio of 0.7).

Our low levels of intangible assets may be more a symptom than a cause. Giving companies data, algorithms, and patents is not going to solve our economic challenges if these companies lack the ideas and expertise to use them effectively. Canadian universities, which are increasingly being asked to ensure that the fruits of their research benefit Canadian companies, often point to the lack of receptors in Canadian industry. IP and other intangible capital can facilitate an innovative strategy by, for example, increasing freedom to operate, but they will generally not cause one.

While Canada largely failed to reimagine during the ICT revolution, and the results are apparent in the data today, we have a chance to redeem ourselves in the coming AI revolution.

5 Prospering in the age of AI

Canadian business and everyday Canadians must urgently begin their AI journey. As a nation, we must determine where we want to play in the AI tech stack and lay the foundations for success in those areas. Becoming an AI nation will necessitate a different paradigm and much broader investments.

5.1 Canada must focus on the application layer

For Canada to prosper in the age of AI we must determine where we can play and win in the AI technology stack.

The infrastructure layer, consisting of hardware and cloud computing has already largely been claimed by foreign companies like Nvidia, AMD, Amazon, Microsoft, and Google. The model layer has similarly already been mostly captured by a small number of firms including OpenAI, Google, Anthropic, Meta, and most recently DeepSeek and Moonshot AI. With the exception of Cohere (who lacks the scale of its competitors), Canada does not have any major players in these bottom layers.

However, Canada can aspire to be a leader in the services, and applications layers. The services layer includes both companies that help customers fine-tune, distill, deploy and/or manage AI models, and model hubs like Hugging Face that host and organize pre-trained AI models, data and code. The applications layer consists both of regular organizations that use AI to do things better, and startups that are reimagining entire industries around AI.

Most of the value from AI will likely be captured in the application layer by businesses that use AI to do things better (*Replace*), and by entrepreneurs who reimagine entire industries (*Reimagine*). The example of the last GPT, the Internet, is again instructive. Before services and applications could be built, the infrastructure had to be laid. Cisco and Nortel were thus among the early winners. But ultimately, most of the value was captured by the people and businesses that leveraged the Internet to improve operations, and by entrepreneurs like Jeff Bezos and Mark Zuckerberg who reimagined entire industries and, in doing so, created some of the world's most valuable firms.

Another reason to be optimistic about the opportunities in the applications layer is the availability of best-in-class open-weight models. A major concern among economists and regulators is that a small set of players could come to dominate the model layer and effectively tax all activity in the layers above. While this could yet occur, the industry seems to be moving in the opposite direction. Not only are there an increasing number of model entrants (Grok, DeepSeek v3 and R1, AutoGLM, Qwen), but there are also best-in-class models that are mostly free and open-weight (e.g., Llama 3.1, DeepSeek v3, Moonshot AI's Kimi K2). Even OpenAI has begun to offer open-weight models[9]. Open-weight models are modifiable, shareable and can be self-hosted, even for commercial applications (subject

[9] "Open weights and AI for all." August 5, 2025. https://openai.com/global-affairs/open-weights-and-ai-for-all/

to the specific licensing terms). Meta recently announced that its Llama family of models had been downloaded one billion times and is already in use by major players like Spotify, AT&T and DoorDash (Wiggers, 2025).

Dropping inference costs will also expand the possibilities for *Replace* and *Reimagine*, making some applications that were previously too expensive suddenly viable. The cost of operating a large language model (LLM), measured as the price per 1M tokens, is estimated to be dropping by a factor of between 9 and 900 times each year depending on the benchmark level of performance (Appenzeller, 2024; Cottier et al., 2025).[10]

We are starting to see the applications of AI proliferate across the economy. The website "*There's an AI for that*" counts over 39,893 AI tools for 13,589 tasks and 5042 jobs.[11]

Despite this, we are only at the beginning of the adoption journey. Previous GPTs have taught us that adoption is a marathon, not a sprint. Canada still has time to catch up, but doing so will require urgent action and a clear-eyed focus on the applications layer (*Replace* and *Reimagine*).

5.2 A Canadian AI Strategy

Unfortunately, Canada's AI strategy is stuck in the wrong paradigm. Canada invested in AI research for decades, but when the technology matured and became commercially valuable, others stepped in to reap the rewards. We appear not to have learned our lesson. Of Canada's recently announced $2.4B investment in AI, the vast majority ($2B) was allocated to compute infrastructure, which largely benefits researchers and pure-play AI companies like Cohere. A mere $300M (12.5%) was earmarked for fostering adoption and helping start-ups that are using AI to *reimagine* traditional sectors.

The most recent signals from the newly-elected government are encouraging. The appointment of a Minister of AI and Digital Innovation highlights AI's prominence in the government's agenda. The new Minister lists AI adoption as one of his top priorities. During the recent G7 Summit hosted by Canada, the leaders issued a statement that "*We intend to double down on AI adoption efforts that connect research to practical applications, helping businesses—especially SMEs—integrate AI technologies that drive productivity, growth and competitiveness.*"

If Canada is serious about making broad-based adoption a reality, we must urgently develop a comprehensive AI strategy and implement its programs and policies. Such a

[10] For comparison, Moore's Law implies a drop of approximately 1.6x per year.
[11] Numbers as of August 13, 2025. https://theresanaiforthat.com

strategy must both promote the adoption of AI by existing businesses to raise overall productivity (engaging in *Replace*) and create the future economic champions by fostering the entrepreneurial firms that reimagine traditional industries around AI (*Reimagine*). This will require foundational elements supporting both *Replace* and *Reimagine*, but also initiatives that are specifically focused on each.

Figure 6 outlines the critical elements of a comprehensive AI strategy. We begin the discussion with the foundational elements of a national AI strategy, then focus on policies to support adoption (*Replace*) and entrepreneurship (*Reimagine*).

Foundational Elements:

1. AI research:

Sustained investment in AI research ensures that Canadian businesses and startups have ready access to the latest technologies. Strong research, particularly in universities, also helps develop future AI talent.

Due to decades-long investment, Canada continues to be among the global leaders in AI research (Maslej et al., 2024). This constitutes one of our comparative advantages. However, we must do a better job of ensuring that research translates to commercial success by also investing in the other pillars.

2. Regulatory clarity:

Clear, coherent, and light-touch regulations reduce policy uncertainty and increase trust, thereby encouraging AI adoption. Harmonization with major trading partners, particularly the United States, allows businesses to more easily span markets. The use of regulatory sandboxes enables experimentation and innovation while protecting consumers. Regulations also need to be flexible and nimble given that the direction of AI deployment is difficult to predict, particularly as we enter the *Reimagine* phase where entire industries will be reinvented around the technology.

The now-defunct Bill C-27 aimed to both provide a framework for the safe use of AI and reform privacy laws. To more quickly provide AI clarity, Ottawa should separate AI regulation from legislation on online harms.

3. Data and compute infrastructure:

Data availability can be a barrier to AI adoption, particularly among SMEs and startups. The government can support AI adoption by building and maintaining public data that SMEs

and startups can use to develop or fine-tune models. Because data is non-rival, publicly available data can generate widespread economic benefits.

Data sets should use common standards, protect privacy, and include metadata that makes them directly usable for training and fine-tuning AI systems. Access through application programming interfaces (APIs) enables real-time, programable use of the data. Widespread data availability can also encourage more competition and make models more transparent and easier to audit.

Access to reliable and affordable computing power can also foster adoption by reducing costs and risks. Sovereign compute can mitigate geopolitical risks. Given the cost of building computing infrastructure, government investments should be leveraged through partnerships with private investors to achieve a multiplier effect and to ensure that facilities remain state-of-the-art.

4. AI literacy and education:

The launch of ChatGPT fundamentally democratized access to AI because for the first time non-experts could use AI tools using natural language. As a result, AI now has the potential to empower not just those who are technically savvy, but all Canadians.

Through widespread literacy and education, AI can become a comprehensive and inclusive engine of growth. Unfortunately, AI literacy remains Canada's most neglected foundational element.

Canada must engage in a mass AI literacy campaign that builds awareness, trust, and excitement. Public awareness campaigns emphasizing practical AI literacy and an openness to technological change can shift societal perspectives from caution to optimism, building a culture that is open to change. A comprehensive national AI skills and training initiative, spanning all educational levels and corporate sectors, can foster an AI-ready culture and workforce. Everyone, from high school students to executives, must better understand AI's challenges and opportunities.

It is only by mobilizing the creativity and ingenuity of all Canadians that we may begin to *Replace* and *Reimagine* at pace. Much of the AI adoption (*Replace*) in existing businesses is not happening as a result of executive initiatives, but rather is bubbling up through organizations as workers experiment with the technology and share their learnings with colleagues. Educating more Canadians and instilling a sense of openness to the technology will therefore increase the rate of adoption.

Broad literacy and education will foster *Reimagine* as well. The entrepreneur that will see and seize the opportunity to create the Amazon or Meta of the AI age will not necessarily be

a computer scientist, or even a university graduate. It is only by harnessing the power of all Canadians and letting a thousand flowers bloom that we may grow the AI-native companies that will redefine current industries around AI or even invent entirely new ones.

Moreover, investing in our people will not only increase our chances of increasing business productivity and creating world-beating firms, it will also ensure that the benefits are more broadly shared in society.

Yet, perplexingly, investments in AI literacy and education are almost entirely missing from Canada's current AI plans. Canada needs to invest in its people and this should include, among other things, public lectures, awareness campaigns, educating executives, AI education tax credits, and the creation of massive open online courses targeted to all backgrounds and levels of education.

Replace: fostering AI adoption

Beyond the foundational elements of an AI strategy, a number of different initiatives can target broader AI adoption by existing businesses (especially SMEs). These include:

1. **Incentivising adoption.** SMEs often lack the financial resources to make significant investments in technology and financial incentives including direct (matching) funding, tax credits for investments, and accelerated depreciation of AI capital assets, can accelerate adoption.
2. **Advisory and mentorship services**. Statistics Canada's 2022 Survey of Innovation and Business Strategy, shows that the most frequently cited reason for not adopting an advanced technology is that it is "not applicable to the business's activities" [Statistics Canada 2024b]. For a general purpose technology like AI, that is widely applicable across most if not all sectors, the response suggests a widespread lack of awareness of the technology and its possibilities. Educating SMEs and offering them advisory services (perhaps through IRAP's industrial technology advisors) could help them better appreciate the challenges, possibilities and how to begin the AI journey. The government could also play a convening role in helping SMEs connect with expertise in our research centres.
3. **Use cases, playbooks, and toolkits tailored to different sectors**. A collection of curated sector-specific use cases can give businesses insights into what is possible and the associated expected costs and benefits. Playbooks outline how to implement use cases and toolkits provide some of the required tools (models, code, data, checklists, etc.). While developing use cases, playbooks and toolkits poses a

significant up-front cost (and their maintenance an ongoing cost), once created they present a highly scalable way to promote AI adoption.

4. **Adopting AI in the public sector.** Public sector adoption creates visible proofs of concept and illustrations of the benefits of AI adoption. The effective use of AI to challenges like triaging immigration applications, Canada Revenue Agency's customer support, and optimizing healthcare wait times can help shift the public perception of AI from its current focus on risks, and provide templates for successful uses and implementations. As a highly visible entity, the Federal government has an opportunity to lead by example.

Reimagine: fostering AI entrepreneurship

Many of Canada's future economic champions will emerge through AI entrepreneurship: both AI technology firms that carve out a niche in the AI industry, but especially firms in traditional sectors that embrace an AI-native business model to transform and become a leader in their industry. Promoting AI entrepreneurship is therefore a crucial element of a national AI strategy.

In addition to the foundational elements already discussed, AI entrepreneurship can be fostered through more targeted initiatives including:

1. **AI venture development programs, incubators, and accelerators**. AI founder and venture development programs can help individuals target problems, validate ideas and become effective founders. These can be particularly instrumental in channeling the attention of founders toward the more ambitious opportunities of reimagining entire industries and can impart some of the tools (such as the *Reimagine* lenses discussed in section 3.2) necessary to do so. Incubators can later provide workspaces, advisors, shared services and prototyping equipment to nurture young businesses, and accelerators can help them scale more quickly.
2. **Research commercialization grants.** Canada can increase the pipeline of AI companies with research commercialization grants that can bridge the gap between AI academic research and market-ready innovation. Such grants can provide non-dilutive funding to researchers and early-stage firms to support activities such as data curation, model development, protecting intellectual property, and developing prototypes.
3. **Early-stage funding and sovereign venture capital**. Early-stage capital provides startups and young firms the ability to move from concept or prototype toward initial commercialization. Government could provide capital through direct grants, or by

partnering with angel investors and other organizations. Even when startups establish recurring revenue, they can require additional capital to sustain or accelerate growth. Sovereign AI venture capital can provide the required capital while ensuring that successful scale-ups stay in Canada.

4. **Public challenge funds.** Open problem-focused competitions where innovators and entrepreneurs compete for funding tied to solving specific societal challenges could at once foster AI entrepreneurship and direct innovation towards social challenges. For example, Impact Canada's Challenge Platform could run a competition for ventures to find ways to use AI to increase agricultural yields or improve our health care system while making it more sustainable. Such a program with staged milestones could provide seed funding, data and access to compute, as well as ongoing support for the more promising projects, thereby derisking innovation and facilitating the transition from ideas to commercializable products and services.
5. **Public procurement.** By acting as an early and reliable customer, government can reduce market uncertainty and provide startups with critical opportunities to validate and scale their innovations. Expanding defense budgets, in particular, can support the development and commercialization of dual-use technologies like AI for cybersecurity or Arctic surveillance.

While Canada already has many of these elements in place, we must recognize that AI is the principal technology that will transform our economy and society over the coming decades. We must therefore put forward a suite of programs designed to seize its specific opportunities.

Finally, the capstone of a national AI strategy is a set of ambitious targets and associated metrics. Canada should publicly declare the goal of boosting productivity by achieving the highest rates of AI adoption in the G7. To identify barriers and track progress, we must develop a set of broad, real-time, AI adoption metrics, using traditional data like business surveys and novel datasets like job postings and AI usage by individuals.

5.3 AI Policy in Comparator Countries

Understanding the AI-related policies of other countries can both offer an evaluation of where Canada stands, and provide ideas for how to do things better. Table 2 summarises the activities of Canada, the UK, Singapore, and Taiwan for each of the AI policy pillars outlined above. Each pillar is discussed below.

1. AI Research

All four countries have made significant investments in AI research. However, Canada stands out for its decades-long sustained investments.

In 2017, Canada launched the C$125 million Pan-Canadian AI Strategy, billed as the world's first national AI Strategy.[12] Its objectives were narrow, focusing on supporting AI research and cultivating top AI talent through its three national institutes (Amii, Mila, and Vector). While the narrow focus of the Strategy in part explains Canada's lagging AI adoption, it did help Canada remain among the global leaders in AI research (Maslej et al., 2024). Budget 2021 proposed an additional C$443.8 million over ten years for a slightly broader phase 2 that also included funds for commercialization, computing power, and the development of standards (Department of Finance, 2021).

In the UK, the Alan Turing Institute develops talent and supports data science and AI research. In 2024, it received an additional £100 million investment over five years from UK Research and Innovation (UKRI) and the Engineering and Physical Sciences Research Council (EPSRC).[13] That same year, UKRI and EPSRC also announced £80 million to fund nine new AI research hubs.[14] UKRI also supports the training of AI doctoral researchers. In 2018, it invested £100 million to fund 16 AI Centres for Doctoral Training, followed by a further £117 million for 12 new centres in 2023. These new centres will train around 900 students over eight years.[15]

Singapore conducts AI research through its Agency for Science, Technology and Research (A*STAR) and AI Singapore's (AISG) research grants. Taiwan funds AI research primarily through its National Science and Technology Council (NSTC).

2. Regulatory Clarity

With the demise of Bill C-27, Canada does not currently have horizontal AI regulation, relying instead on guidance in the form of the 2023 Voluntary Code of Conduct on the

[12] The Pan-Canadian AI Strategy. https://cifar.ca/ai/. Accessed October 28, 2025.
[13] £100 million investment in the Alan Turing Institute Announced. https://www.ukri.org/news/100-million-investment-in-the-alan-turing-institute-announced/. Accessed October 28, 2025.
[14] £100 million boost in AI research will propel transformative innovations. https://www.ukri.org/news/100m-boost-in-ai-research-will-propel-transformative-innovations/. Accessed October 28, 2025.
[15] How we work in artificial intelligence. https://www.ukri.org/who-we-are/our-vision-and-strategy/tomorrows-technologies/how-we-work-in-ai/ukri-artificial-intelligence-centres-for-doctoral-training. Accessed October 28, 2025.

Responsible Development and Management of Advanced Generative AI Systems[16] and the 2025 Implementation Guide for Managers of Artificial Intelligence Systems.[17]

The UK deliberately avoided an AI act, opting instead for a framework based on five principles (safety, transparency, fairness, accountability, contestability) and asking existing regulators to ensure the application of the principles (Department for Science, Innovation and Technology, 2023). Singapore's approach has similarly focused on providing guidance through its Model AI Governance Framework and Model AI Governance Framework for Generative AI (AI Verify Foundation, 2024), and on offering an AI Verify toolkit that users can employ to conduct technical tests of their AI models.[18] Taiwan's Executive Yuan, on the other hand, recently approved a Basic Act on AI that sets guiding principles and aims to encourage innovation while protecting intellectual property rights and personal data.[19] The UK and Singapore have also put in place regulatory sandboxes to give innovators a space to experiment with AI applications. Taiwan does not yet have AI regulatory sandboxes, but the Basic Act on AI is requiring agencies to create them.

3. Data and Compute Infrastructure

While all four countries operate data portals offering open access to some government data,[20] they differ in the extent, quality and purpose of the available data. While Canada's portal has as its main objective to "enhance accountability and transparency," Singapore's has the explicit goal of supporting AI development and offers more than 5000 datasets (often accessible through APIs). Singapore has also developed a Trusted Data Sharing Framework[21] providing templates and a common data-sharing language to facilitate data sharing between organizations.

All four countries are investing in compute infrastructure. Canada's investments are among the most ambitious, having announced in its 2024 Budget C$2 billion over five years for the Canada Sovereign AI Compute Strategy, including C$700 million to mobilize private sector

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[16] Voluntary Code of Conduct on the Responsible Development and Management of Advanced Generative AI Systems. September 2023. https://ised-isde.canada.ca/site/ised/en/voluntary-code-conduct-responsible-development-and-management-advanced-generative-ai-systems.

[17] Implementation Guide for Managers of Artificial Intelligence Systems. https://ised-isde.canada.ca/site/ised/en/implementation-guide-managers-artificial-intelligence-systems. Accessed October 29, 2025.

[18] Singapore's Approach to AI Governance. https://www.pdpc.gov.sg/help-and-resources/2020/01/model-ai-governance-framework. Accessed October 29, 2025.

[19] Executive Yuan approves draft bill for basic law on AI. August 28, 2025. https://english.ey.gov.tw/Page/61BF20C3E89B856/89da216e-5741-43e4-aac8-af4551a21499.

[20] Portals are https://open.canada.ca, https://www.data.gov.uk, https://data.gov.sg, and https://data.gov.tw Accessed October 30, 2025.

[21] Trusted Data Sharing Framework. https://www.imda.gov.sg/-/media/imda/files/programme/data-collaborative-programme/trusted-data-sharing-framework.pdf. Accessed October 30, 2025.

investment, C$1 billion to build public supercomputing infrastructure, and C$300 million for an AI compute access fund.[22] The UK Compute Roadmap commits £1 billion to expand the AI Research Resource offering both academia and industry access to advanced supercomputers, and a further £750 million for a new national supercomputer (Department for Science, Innovation and Technology, 2025). Singapore and Taiwan provide researchers and industry access to compute through their National Supercomputing Centre and National Center for High-Performance Computing, respectively.

4. AI Literacy and Education

AI literacy and education is the pillar where Canada is most lacking, with no significant national campaign to promote AI literacy or skills.

In contrast, the UK recently announced a major national skills drive that will give 1 million secondary school students skills in technology and AI, and that in partnership with major tech companies including NVIDIA, Google, and Microsoft, will train 7.5 million workers by 2030.[23]

Singapore's National AI Strategy 2.0 aims to create a "Whole-of-Nation Movement" (Singapore National AI Strategy, 2023) with broad AI literacy and skills as major pillars. Digital for Life[24] aims to strengthen digital inclusion through digital literacy and includes major AI components. Singapore's SkillsFuture[25] program supports lifelong learning and offers citizens yearly credits for upskilling. AI Singapore offers courses[26] to the general public, industry, and students, while its AI Student Outreach Programme[27] promotes AI literacy and experimentation with AI tools among secondary and post-secondary students. Taiwan's emphasis on AI literacy is mainly focused on educating students through AI Literacy for All[28] and related initiatives.

The above pillars (AI research, regulatory clarity, data and compute infrastructure, and literacy) provide the necessary foundations for accelerating AI adoption and AI

[22] Canadian Sovereign AI Compute Strategy. https://ised-isde.canada.ca/site/ised/en/canadian-sovereign-ai-compute-strategy. Accessed October 30, 2025.
[23] PM launches national skills drive to unlock opportunities for young people in tech. June 8, 2025. https://www.gov.uk/government/news/pm-launches-national-skills-drive-to-unlock-opportunities-for-young-people-in-tech.
[24] Digital for life. https://www.imda.gov.sg/about-imda/who-we-are/digital-for-life. Accessed October 30, 2025.
[25] SkillsFuture. https://www.skillsfuture.gov.sg. Accessed October 30, 2025.
[26] AI Singapore Talent Development. https://learn.aisingapore.org. Accessed October 30, 2025.
[27] AI Singapore Students. https://learn.aisingapore.org/students-2/. Accessed October 30, 2025.
[28] Day of AI. https://dayofai.org/taiwan-ai-literacy-for-all/. Accessed October 30, 2025.

entrepreneurship. In addition to building these foundations, each country has rolled out initiatives that are specific to fostering AI adoption or AI entrepreneurship.

5. Adoption by Existing Firms

As part of Budget 2024's $2.4 Billion AI package, Canada allocated $200 million through its regional development agencies to help address Canada's AI adoption gap and to help startups and growing firms commercialize AI products and services.[29] The same package allocated $100 million to the IRAP AI Assist Program to help SMEs deploy AI solutions. Canada could do more to foster AI adoption, not just by increasing funding for adoption, but also by creating use cases, playbooks, and toolkits, and by accelerating government AI adoption.

Other countries are also deploying programs to foster AI adoption. The UK's BridgeAI[30] offers support and funding for sectors with high growth potential but lower levels of AI adoption. The UK is also a leader in government AI adoption, signing AI contracts totalling £573 million in just the first half of 2025 (Gabert-Doyon, 2025).

Singapore and Taiwan have also created programs incentivizing adoption and offering mentorship and expertise, though they tend to be more broadly focused on the whole of digital technologies. Singapore's SMEs Go Digital Industry Digital Plans[31] offer sector-specific, step-by-step digital playbooks to help enterprises map out their adoption journey. Taiwan has launched a NT$ 4.5 billion program to promote AI adoption in South Taiwan.[32] It has also built on Llama to develop its own sovereign Trustworthy AI Dialogue Engine (TAIDE) LLM and made it open source in an effort to foster adoption.[33]

6. AI Entrepreneurship

AI entrepreneurship is essential to create tomorrow's economic champions. Canada has many AI founder and venture development programs including NextAI, AI2Market, the Creative Destruction Lab, and Scale AI's Acceleration Program.[34] Canada's Regional Artificial Intelligence Initiative is, as already discussed, in part helping startups commercialize products and services. Innovative Solutions Canada has created an AI

[29] Securing Canada's AI Advantage. April 7, 2024. https://www.pm.gc.ca/en/news/news-releases/2024/04/07/securing-canadas-ai.
[30] BridgeAI. https://iuk-business-connect.org.uk/programme/bridgeai/. Accessed October 31, 2025.
[31] Industry Digital Plans. https://www.imda.gov.sg/how-we-can-help/smes-go-digital/industry-digital-plans. Accessed October 31, 2025.
[32] Office of Science and Technology Policy. July 14, 2025. https://ostp.nstc.gov.tw/NewsContent.aspx?id=45
[33] Trustworthy AI Dialogue Engine. https://en.taide.tw. Accessed October 31, 2025.
[34] https://www.nextcanada.com/next-ai/, https://www.ai2market.ca, https://creativedestructionlab.com, and https://www.scaleai.ca/acceleration/, respectively. Accessed October 31, 2025.

stream to test and fund late-stage pre-commercial prototypes that have the potential to address government requirements.

All three comparator countries also have AI-focused founder and venture development programs. Singapore offers venture support programs through AI Singapore, including its flagship 100 Experiments program[35] that helps organizations transform AI use cases into minimum viable products in just 6 months.

Canada lags the comparator countries in government early-stage AI funding. The UK's Sovereign AI Unit[36], with £500 million in funding, has within its mandate investing in high-potential AI startups to help them scale in the UK. Singapore and Taiwan have also created funds to invest in startups. Canada should consider the creation of a sovereign AI fund that would not only help startups commercialize and scale but would mitigate the risk of them moving abroad to access funding.

All three comparator countries also use challenge funds. The UK encourages AI entrepreneurship and innovation through the UK Research and Innovation Challenge Funds[37], while Singapore has AI-focused Challenge funds through both AI Singapore[38] and Enterprise Singapore.[39]

The UK Department for Science, Innovation and Technology also recently announced the Commercial Innovation Hub[40] that takes advantage of the increased flexibility of the new Procurement Act[41] to make it easier for SMEs to participate in government procurement.

6 Conclusion

Canada finds itself at a critical juncture. As our productivity gap widens and economic growth stalls, artificial intelligence presents a rare and urgent opportunity to reshape our economic trajectory. But if Canada is to prosper in the age of AI, and not fall further behind our economic peers, we must acknowledge past mistakes and embrace a new paradigm.

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[35] 100 Experiments. https://aisingapore.org/innovation/100e/
[36] Sovereign AI Unit. July 17, 2025. https://www.gov.uk/government/collections/sovereign-ai-unit
[37] UK Research and Innovation Challenge Fund. https://www.ukri.org/what-we-do/ukri-challenge-fund/. Accessed October 31, 2025.
[38] AI Singapore Grand Challenges. https://aisingapore.org/technology/grand-challenges/. Accessed October 31, 2025.
[39] Enterprise Singapore AI Open Innovation Challenge. https://open.innovation-challenge.sg/en/challenges/aioic-2024. Accessed October 31, 2025.
[40] Commercial Innovation Hub. June 13, 2025. https://www.gov.uk/guidance/commercial-innovation-hub
[41] Procurement Act 2023: short guides. November 13, 2023. https://www.gov.uk/government/publications/procurement-act-2023-short-guides

The goal cannot be to simply create a national AI champion. Even if Cohere or some other Canadian entity succeeded in being among the world's big LLM developers, this would not significantly alter Canada's economic trajectory. Canada doesn't need one engine, we need thousands. We don't need an AI company, but an AI Nation.

Canada must become a country where the use of AI becomes a shared civic skill, woven into the economy and society, empowering every person and organization to thrive in the age of intelligence. We must integrate AI into all our economic activities (not only the technology sector) by building a culture of openness to change and embedding AI into our national identity. AI is not an industry to be won, it is a tool to empower all Canadians.

Seizing this opportunity will require a fundamental shift in how we approach the AI revolution: not as a research exercise led by a small set of organizations, but as a broad-based economic transformation involving government, industry, and citizens.

As a general purpose technology, AI adoption will follow the same path as previous GPTs: from the replacement of current technologies within existing processes, to the reimagining of entire business models, and eventually to the recombination with other technologies to generate entirely new ones. This 3R Framework offers both a glimpse into the future and guidance on how to seize AI's opportunities.

This path forward offers not only the potential to boost productivity, but also to address persistent challenges in healthcare, education, and beyond. However, realizing these gains will require more than just technical capability. It will demand imagination, entrepreneurship, a cultural shift, and the political will to embark on a program of change.

Unfortunately, Canada's current AI strategy remains overly focused on research and infrastructure. While these are necessary components, they are insufficient to drive widespread adoption or ensure inclusive economic benefit. Other countries, such as the UK and Singapore, have recognized that national competitiveness in the age of AI depends not just on creating technology, but on its diffusion and application across the whole economy. Their approach, centered on mass upskilling and broad adoption in both the public and private sectors, offers a roadmap that Canada would do well to follow.

To prosper in the age of AI, Canada must embark on a massive nation-building project akin to the Canadian Pacific Railway of the late 19th century. We must mobilize the ingenuity and ambition of all Canadians. This will require a mass AI literacy campaign, deeper investments in AI capability across firms and sectors, and fostering a culture that is open

to change. We must stop wishing for a single national AI champion and instead cultivate a country of AI builders, adopters, and “reimaginers”.

The lesson from past technological revolutions is clear: the future belongs to those who build it. Canada must act now to ensure it does not get left behind.

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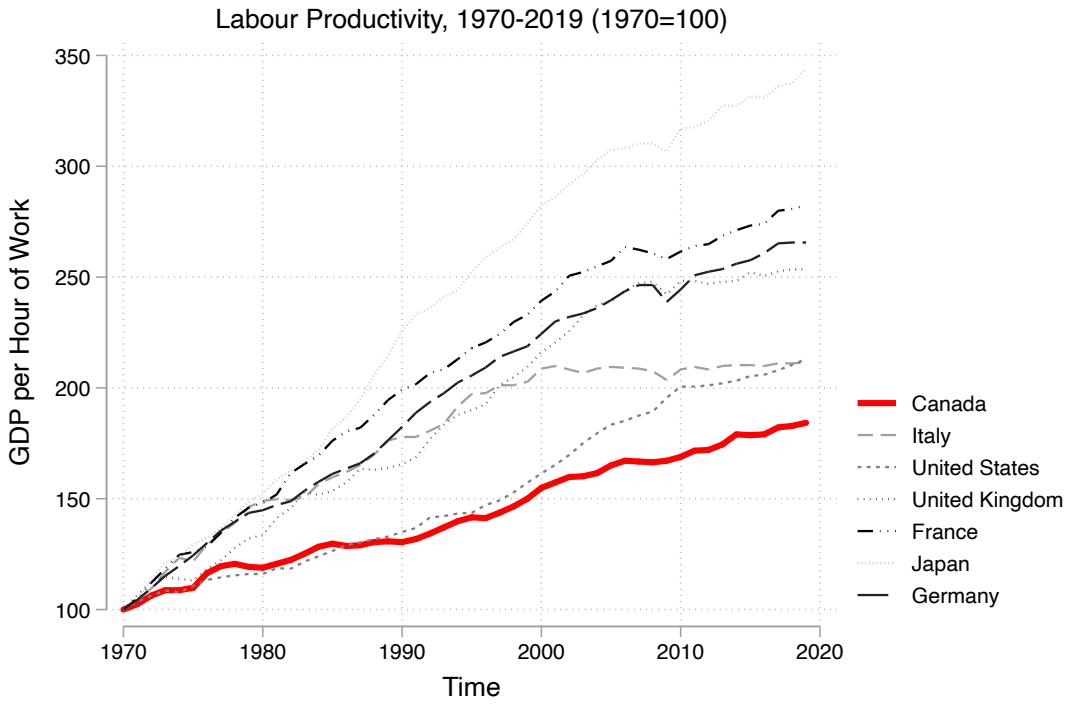
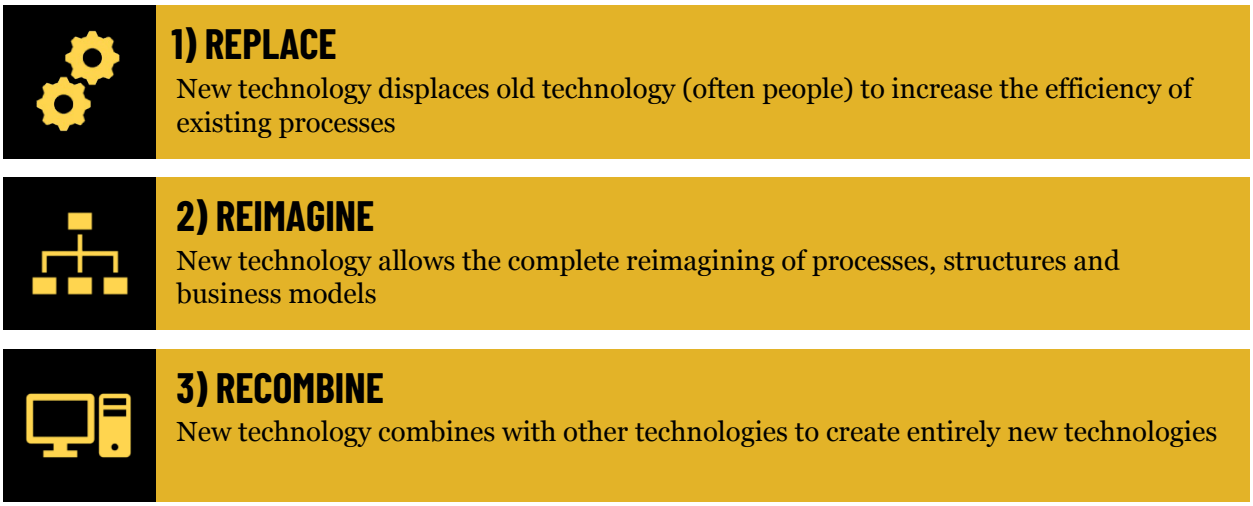
Figures

Figure 1: Labour Productivity Growth for Canada and other G7 countries



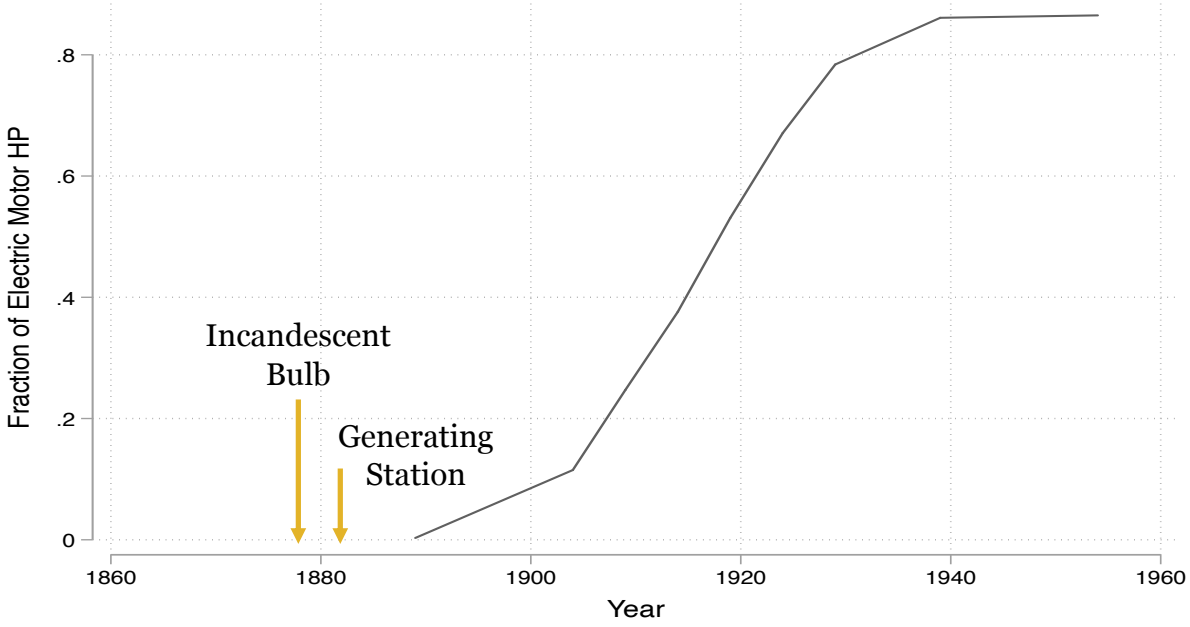
Notes: Growth in GDP per hour of work for Canada and the other G7 countries measured in USD constant prices, converted using 2015 purchasing power parity. Data source: OECD Productivity Indicators.

Figure 2: The 3R Framework: Replace, Reimagine, Recombine



Notes: the 3R Framework captures the three phases of adoption of general purpose technologies.

Figure 3: Penetration of electric motor horsepower in U.S. manufacturing



Notes: Estimated electrification of mechanical drive in U.S. manufacturing establishments. Primary and secondary electric motor horsepower (HP) as a proportion of total mechanical drive in manufacturing. Data source: David (1989) Table 3.

Figure 4: AI reimagine lenses

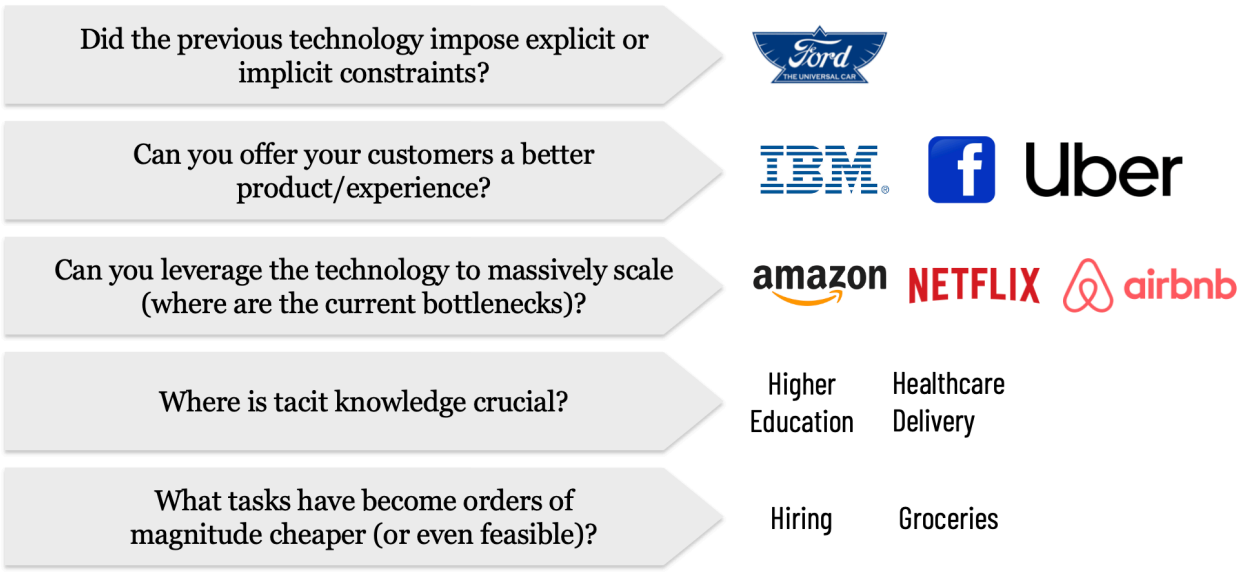
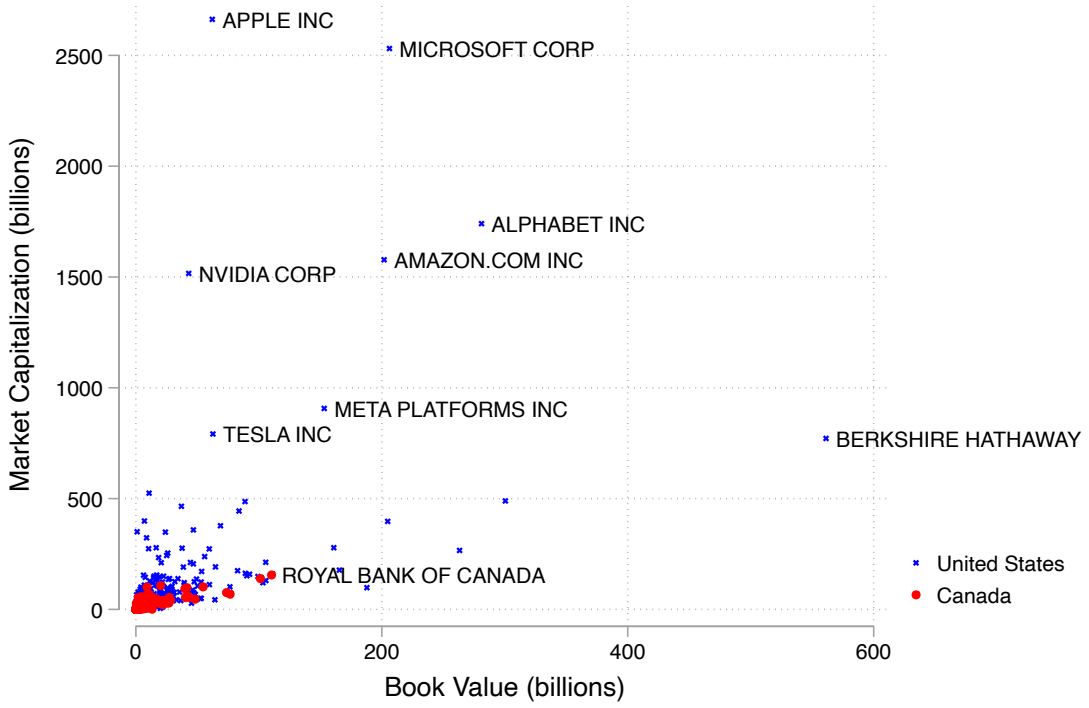
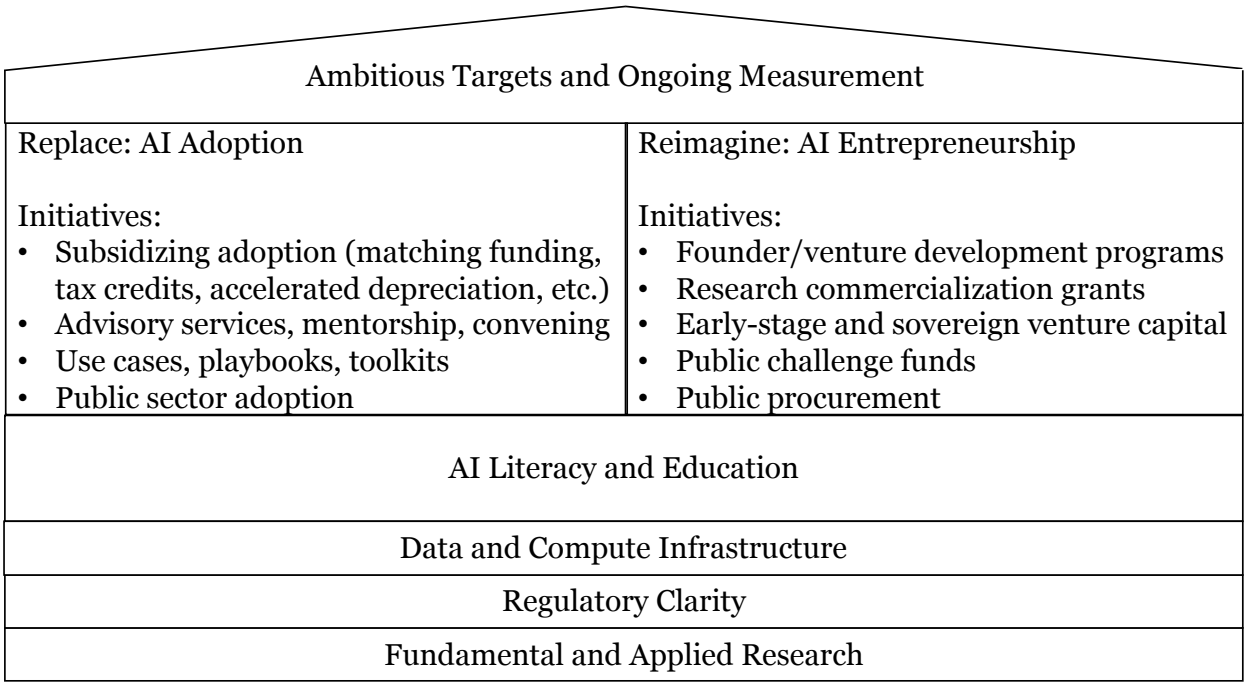


Figure 5: Market Capitalization and Book Value, 2023



Notes: Market capitalization and book value of public companies with headquarters located in Canada and the United States. Data is from the Compustat North America for the fiscal year 2023. The difference between market capitalization and book value is a rough measure of intangible assets.

Figure 6: Policies to support AI adoption and AI entrepreneurship



Notes: Policies and programs to support AI adoption (*Replace*) and AI entrepreneurship (*Reimagine*)

Tables

Table 1: List and Categorization of Generative AI Capabilities

Capability	Tasks Generative AI Can Perform
Writing	Synthesize text, Edit text, Evaluate text, Generate titles, Generate tweets, Customize content
Ideation	Brainstorm concepts, Evaluate ideas, Generate alternatives, Suggest improvements, Provide counterarguments, Generate names
Background Research	Retrieve information, Summarize information, Conduct literature review, Explain complex topics, Translate text, Generate literature reviews
Coding	Write code, Explain code, Translate code, Debug errors, Comment code, Suggest libraries/packages
Data Analysis	Gather data, Extract data from text, Clean data, Visualize data, Analyze data, Extract sentiment
Math	Set up model, Derive equations, Explain models, Generate proofs, Simplify expressions, Explain concepts
Advising	Respond to questions, Provide recommendations, Assess pros and cons, Identify risks, Generate action plans, Personal tutor
Innovation	Generate product ideas, Suggest novel use cases, Recommend improvements, Identify new opportunities, Propose solutions, Conduct experiments
Reporting	Draft summaries, Extract insights, Generate presentations, Analyze performance metrics, Automate recurring reports, Take meeting minutes
Accounting	Classify transactions, Generate financial statements, Identify anomalies, Summarize budget reports, Manage expenses, invoice reconciliation
Image Generation	Generate images from prompts, Modify existing images, Create visual mock-ups, Generate logos and branding, Design infographics, Prepare presentations
Video Generation	Generate short videos from text, Edit video content, Add effects to footage, Synthesize voiceovers, Create animated explainer videos, Generate realistic deepfake videos
Music Generation	Compose original music, Generate background music tracks, Create sound effects, Remix existing audio, Suggest musical themes, Customize music to moods or scenarios

Notes: The table builds on Korinek (2023), updating and augmenting this early work based on interactions with executives from dozens of companies. The list is by no means exhaustive and the breadth of tasks that generative AI can perform continues to expand.

Table 2: Cross-country comparison of initiatives by AI policy pillar

Pillar	Canada	UK	Singapore	Taiwan
AI research	Pan-Canadian AI Strategy (CIFAR, Mila, Vector, Amii)	Alan Turing Institute; UKRI/EPSRC AI research hubs	A*STAR; AI Singapore	National Science and Technology Council
Regulatory clarity & frameworks	Collapse of Bill C-27; Voluntary gen-AI code of conduct; Implementation Guide for Managers of AI Systems	"AI Regulation: A Pro-Innovation Approach" principles-based White Paper; Regulatory sandboxes	Model AI Governance Framework; Model AI Governance Framework for GenAI; GenAI Evaluation Sandbox	AI Basic Act
Public data & compute infrastructure	Open.canada.ca portal; Canadian Sovereign AI Compute Strategy ($2B)	Data.gov.uk portal; National Data Library; AI Research Resource	Data.gov.sg portal; National Supercomputing Centre	Data.gov.tw; National Centre for High-Performance Computing
AI literacy & education	No national campaign	AI skills drive (1M students, 7.5M workers)	AI for Everyone, AI for Industry, AI Student Outreach Programme; Digital for Life; SkillsFuture Credit	AI Literacy for All Initiative
Adoption by existing firms	Regional Artificial Intelligence Initiative ($200M); IRAP AI Assist Program ($100M) Scale AI	Made Smarter Initiative; BridgeAI sector programs; Government adoption (£573M)	Enterprise Development Grant; SMEs Go Digital productivity solutions; SMEs Go Digital Industry Digital Plans	TAIDE LLM; South Taiwan AI Adoption Program (NT$4.5B)
AI entrepreneurship	Scale AI Accelerator Program; Regional Artificial Intelligence Initiative ($200M); Innovative Solutions Canada AI Stream	Sovereign AI Unit investments; UK Research and Innovation Challenge Funds; Commercial Innovation Hub; Innovate UK Contracts for Innovation	SGInnovate; Startup SG Equity Fund; SEEDS Capital; AI Open Innovation Challenge; AI Singapore Grand Challenges; AI Singapore Venture Support Programs	Startup Terrace; Enhanced AI Startup Investment Program (NT$10B)

Note: List of initiatives is not exhaustive and aims to include a breadth of programs and the major government commitments.