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AI, energy and resources: The long view

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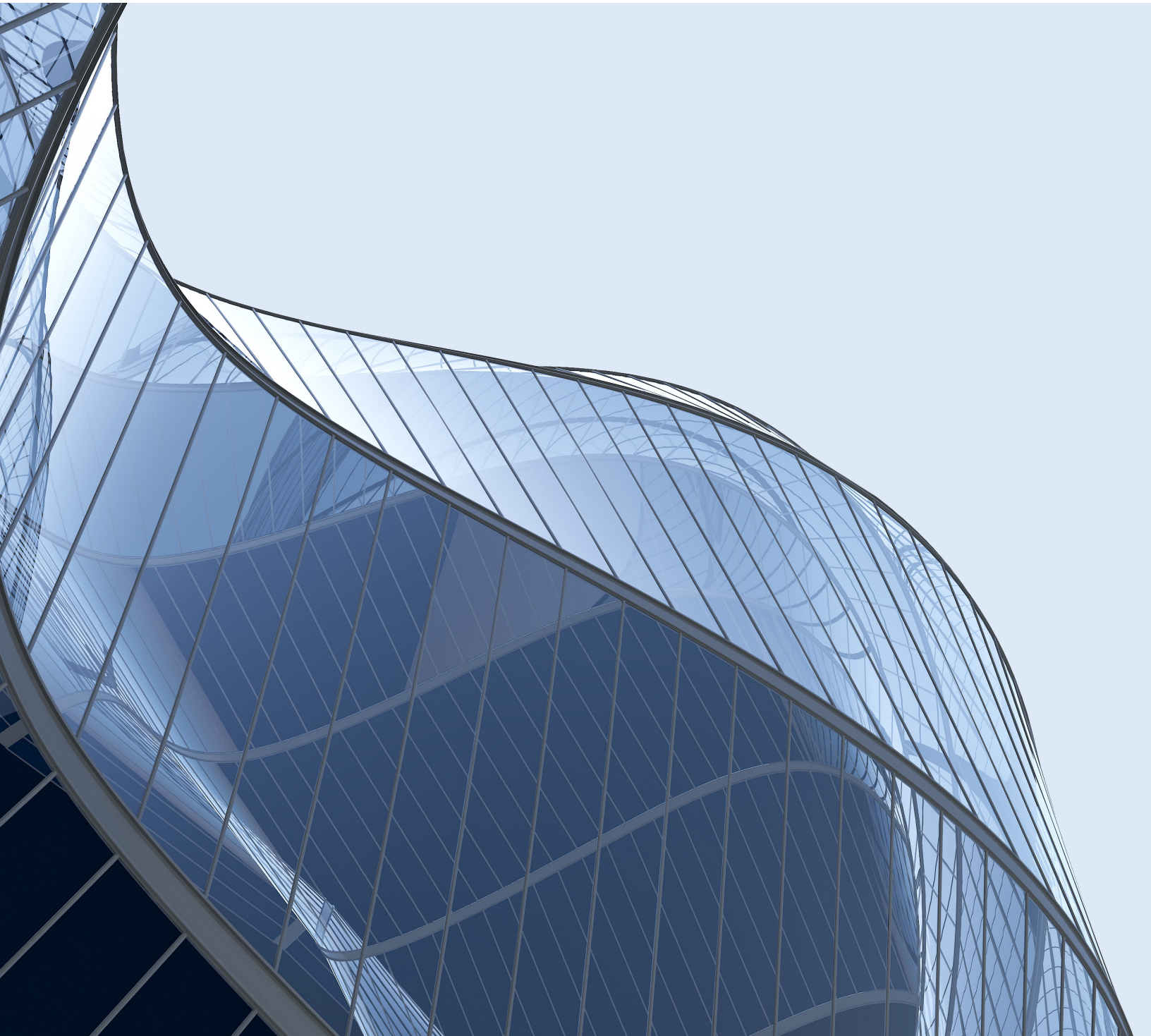
Robertson Velez, CFA, P.Eng, *Portfolio Manager*
Daniel Greenspan, *Senior Analyst and Portfolio Manager*
Fabio Serpa, CFA, *Senior Equity Analyst*
Leo Han, CFA, *Senior Equity Analyst*
Ryan Diamant, CFA, *Client Portfolio Manager*



Many investors are already aware of the immediate opportunities presented by Artificial Intelligence (AI) and Large Language Models (LLMs). These AI tools are increasingly being integrated into the workplace, becoming an integral part of daily life for many Canadians.

However, beyond these immediate applications, we find ourselves in uncharted economic territory. Critical questions remain regarding how AI will influence our lives, reshape business operations, and impact society as a whole. Additionally, the resource requirements—such as energy and metals—that support this transformation pose challenges to sustained growth.

For the long-term investor, this evolution opens up opportunities in both technology and resources sectors.

To discuss these challenges and opportunities, I am joined by esteemed members of the CIBC Asset Management Equities Team: Robertson Velez, Portfolio Manager, Daniel Greenspan, Senior Analyst and Portfolio Manager, Fabio Serpa, Senior Equity Analyst, Leo Han, Senior Equity Analyst, and Ryan Diamant, Client Portfolio Manager.

Mark Obrai (moderator): Robertson, if you were to relate today's AI revolution to historical technological innovations, what stage are we in and what would you consider a similar historical comparison?

Robertson: I would like to give some context for how I think about Technology. At any given moment in time there are always technologies at various stages. It's helpful to look at them not as disparate inventions, but as a series of inventions that build on top of each other. The current focus is on Artificial Intelligence, but this Technology did not spring out of a vacuum. We have been working on AI since the 1960s, and every advance in this field has built on work that has come before. Even the technological failures have been critical in helping to correct the course of our progress.

The current focus of AI is in Generative AI, which is an invention that arose out of the various technical advances in AI over the last several decades. In terms of the stage of technological adoption, I would say that we are still at early stages. Generative AI is considered to have entered the mainstream globally in 2022 with the public release of ChatGPT by OpenAI, so we are just over two years into the Generative AI adoption cycle. This is similar to where the Smartphone adoption was in around 2010. The difference is that Smartphone adoption was easier to measure by looking at displacement of traditional handsets. AI encompasses multiple industries, each with different adoption curves, with potentially a much bigger impact.

Mark: Historically, efficiency improvements (lower input per unit of output) have accelerated adoption of technologies. We saw this with the microprocessor and are now seeing it with AI chips and modeling. Assuming continuous improvement at declining costs, what could the world look like in 10 or 20 years?

Robertson: The current rate of acceleration in the performance/cost curve in AI is estimated to be about 4x per year, meaning that AI performance is expected to quadruple each year for the same cost. If progress in AI maintains this rate of acceleration, we could achieve up to a million times increase in performance over the next 10 years. This means that automation through AI will become the norm, rather than the exception. Let me talk about some specific examples.

Autonomous Vehicles have been in development over the last decade and many vehicles produced today have some level of partial self-driving capability (Level 2 or Level 3 ADAS), and there are Robotaxis in operation that are highly autonomous (Level 4 ADAS), but there are as yet no fully autonomous vehicles (Level 5 ADAS). Over the next 10 years, given the rate of progress with AI capability, I fully expect that most vehicles will be fully autonomous, which will have significant effects on improving safety and traffic.

Humanoid robots have been a staple of science fiction for decades, but are only now becoming reality in industrial applications. For example, Humanoid robots are used today in industrial applications to replace human workers in warehouse operations. The significance of humanoid robots, compared with task-specific robots that have been in use over the past several decades, is the level of flexibility they provide. Most industrial environments are designed to suit human workers, so a humanoid robot is the most versatile in performing human tasks most efficiently.

From an economic perspective, a common question is whether AI is deflationary longer-term. Technology generally is deflationary over time, in the sense that the cost per unit of performance declines exponentially, but this does not necessarily mean that spending on AI will decrease, because lower costs will likely drive higher adoption through improved effectiveness and new use cases.

There are many perceived risks of AI, all stemming from the perception that AI cannot be trusted to make human judgements because AI lacks the human context to distinguish between morally right or wrong choices. To this end, regulation may be necessary to ensure accountability in the acceptable uses of AI, which needs to be resolved over the next decade.

Mark: What technological advancements are needed to reach this vision? Is it now a matter of continuing to improve on what we already know? Or are breakthrough technologies still required?

Robertson: The key challenge in the use of AI today is the distinction between prediction and judgement. AI machines are very good at prediction, and at this point, many would say that AI can make measurably better predictions than humans in many knowledge areas. Generative AI is, in fact, just another form of prediction, where AI can predict the most statistically likely next word in a sentence to answer a question. Judgement is largely still a human activity, however, and we are still at very early stages in terms of trusting AI to make judgements on our behalf. In 10 years, my view is that AI reasoning capability will have improved to the point where AI judgement will be relied upon significantly.

The Holy Grail of AI is to achieve Artificial Generalized Intelligence (AGI), which is the level at which AI is effectively indistinguishable from human intelligence. I think the challenge in achieving this goal is not so much the technical barriers, as much as about the vague definition of what constitutes AGI and our lack of understanding of the nature of our own intelligence, which makes it difficult to know when we have achieved it. Over the next one to two decades, however, I believe we are likely to come close, which will open up various cases in which we can rely on AI to make judgements that are currently reserved for humans.

Mark: Let's shift to the resource requirements and constraints need for this evolution. Dan, Fabio, Leo: energy and metals have been described as limiting variables. As resources experts, which resources do you think are the biggest constraints to the AI revolution? What is needed by governments and resource companies to make this vision of the future feasible?

Leo: Natural gas is and will continue to be instrumental in powering the AI revolution amid increasing demand for electricity and gas-fired power plants. Companies looking to invest in AI and data center development are seeking out large, scalable and affordable sources of power. The Electric Power Institute (EPRI) has a base case forecast for data center power demand in the US, growing at a 5% CAGR from 2023 to 2030, with a high-growth scenario of 15% growth. This could easily translate to 35 GW of incremental electrical demand by 2030 from data centers. In order to supply the incremental electrical power generation, the industry would likely look at natural gas over the next decade given its superior reliability, affordability, availability and scalability. EIA (Energy Information Administration) data shows that there are at least 20.6 GW of gas-fired natural gas power plants on the drawing board, with nearly 88% planned for start-up by 2027. We expect sizable natural gas demand increase as a result.

Fabio: On the Utilities/Infrastructure front, we have seen that key US Data Center markets, like Virginia, situated in the PJM electricity market, are facing constraints from grid reliability, long interconnection queues, and delays in project development. The US grid has been largely underinvested in, both from an upgrading standpoint and from an interregional transmission standpoint. Facilitating investments in interregional transmission would help coordinate the transportation of wholesale electricity in a cost-effective manner to support economic development and Data Center buildouts, while also supporting the reliability of the grid. The expansion, or new build out, of transmission lines and substations would also help alleviate the long interconnection queues seen today, where most projects now have to wait approximately 5 years to get interconnection approval.

Recent reports issued by the PJM indicate concerns about power supply, in part driven by policy objectives that are forcing generation fleet retirements, mainly coal-powered. By 2030, PJM estimates that approximately 40GW of coal-powered generators will be retiring, with ~63% of those retirements being policy-driven, and yet, as at today, there are not enough replacement projects being built to offset the lost GWh of electricity nor to meet the growing load demand. With the continuing trend of electrification in the PJM market, the regional grid operator forecasts that over the next 15 years demand on the system will increase by over 40GW. As a result of the looming supply/demand balance concerns, we have seen PJM auctions resulting in clearing prices of $269.92/MWh for 2025, which is 10X higher than the previous year.

Dan / Fabio: Turning to the metals markets, we note that based on the infrastructure comments previously, a significant investment will be required in the electric grid to support the demand growth expected. That in turn means growing demand for copper, a key component in building out the grid. Recent reports estimate that data centers require ~27 tonnes of copper per installed MW of capacity. BHP (the world's largest copper miner) estimates current copper demand use in data centers at around 500Ktpa and that demand is expected to increase to 3Mtpa by 2050, or the equivalent of 13% of today's current global copper supply. With the copper market close to balanced, increased demand will mean incremental new supply will be needed to meet this new source of demand.

To make this vision of the future feasible, more reasonable regulation of the mining and utilities industry will be important. Governments need to relax policies that will lead to power supply/demand imbalances and also facilitate and improve the regulatory process to incentivize investments in the national grid. In mining, permitting is a major challenge that can take years or even decades to work through. Government de-regulation, while maintaining environmental standards, would go a long way to supporting new investments in the next generation of copper mines. Furthermore, governments around the world can support copper supply growth by ensuring to foreign investors that the rule of law applies, that their mining codes/frameworks provide long-term stability, and that there is a legal framework that provides a path to resolution of any disputes between Governments and mine operators.

Mark: Where are these resources found today? And as AI is at the forefront of a new arms race, what are the geopolitical considerations when accessing these resources?

Leo: North America (both the U.S. and Canada) has plenty of natural gas reserves and we expect growth in supply will come largely from both Canada (namely Montney, and Deep Basin) and the U.S. (Haynesville and Appalachia). TC Energy puts incremental North American power generation growth at 20% for the 2023-2035 time period, with growth in both natural gas and renewables capacity. While electrical power demand growth estimates may vary across power companies, they all point to a very robust growth environment following nearly two decades of relative stagnation. When considering absolute power generation growth, retiring coal facilities should also be considered given the required replacement of baseload power. In the US, there are currently 225 coal facilities operating, while over 25% of that capacity is expected to be retired by 2040, further entrenching the thesis of investment in natural gas generation to meet new demand and to replace some of the existing power load

Dan / Fabio: On the copper side, South America is the key copper producing region with Chile and Peru accounting for ~35% of global copper supply annually. The African copper belt, including the DR Congo and Zambia also account for ~15% of global supply. North American production is smaller with Canada, the United States and Mexico contributing ~10% of global copper supply. Each country faces its own unique challenges when considering geopolitical risks. Changes in government, both in Chile and Peru has created headline-driven volatility in the past, but over time, both these countries have remained of the view that market-friendly policies and stability agreements with foreign investors leads to economic prosperity for the mining sector and the country. In Africa, The DRC has been relatively stable in recent years (for the mining sector), but has a history of challenging relationships with foreign miners that could resurface again the future. Tensions between miners and Governments tend to rise when commodity prices increase and the government feels that it is not seeing the economic benefits it should from the assets in the country. Closer to home, while North America is generally viewed as more stable, there are still significant geopolitical challenges to navigate in these countries as it relates to permitting and the uncertainty in the timelines to complete the process. It remains very challenging to permit new mines in the United States and Canada with opposition groups able to derail timelines by protesting and litigating the permitting process.

Mark: Given projected energy requirements, are we experiencing a nuclear revival? Is there potential for Small Modular Reactors to fulfill this need?

Dan: We are starting to experience a nuclear revival for a number of reasons. There is a growing recognition that renewables like solar and wind are not a panacea for greenhouse gas reductions in the energy sector given the uncertainty of power supply when conditions are unfavourable. Nuclear is gaining traction as a carbon-free source of baseload power that can be used to replace coal and other higher polluting sources of energy generation. Nuclear is increasingly being viewed as a stable, reliable, and relatively clean source of power generation and we expect that nuclear will play an important role in providing consistent low carbon power in the future.

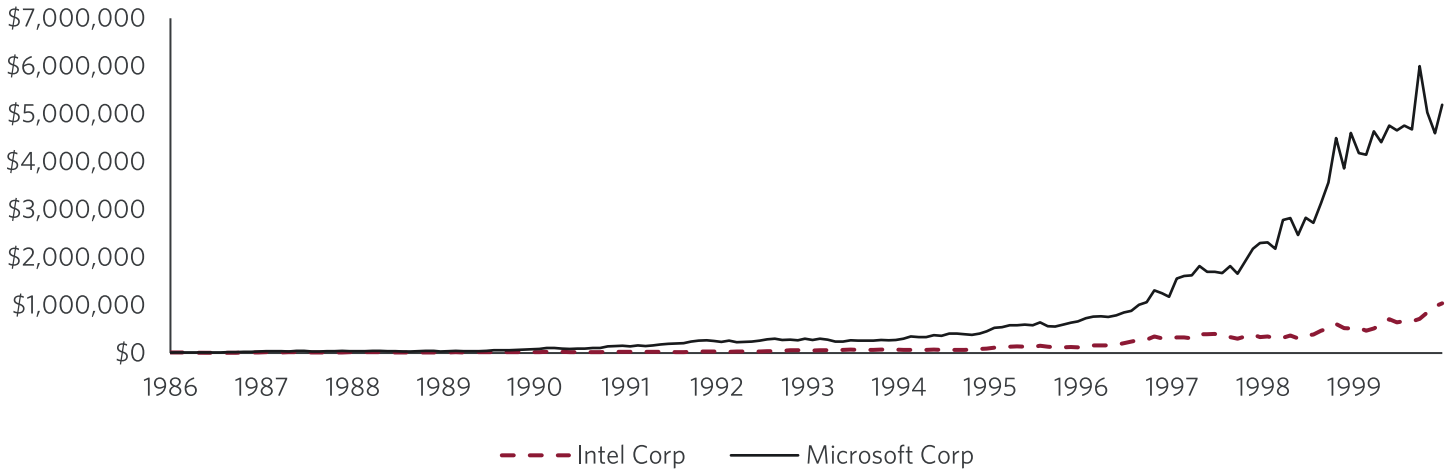
As nuclear relates to data centers and AI, we are seeing clear interest from the hyperscalers to invest in nuclear energy to support their growing power needs. For example, Constellation Energy and Microsoft announced a deal in September 2024 to restart Unit 1 (835MW) at the Three Mile Island nuclear plant (to be renamed the Crane Clean Energy Center). Constellation will spend $1.6bn to refurbish the reactor and will sell the power to Microsoft under a 20-year power purchase agreement. The power will be used by Microsoft for AI data centers. The plant is expected to reopen in 2028 and Constellation is pursuing a license renewal to run the plant to at least 2054. We have also seen Amazon and Google announce investments in small nuclear reactors (SMRs) to support their future needs for carbon free electricity. We would say that SMRs are at this point still blue-sky upside to the nuclear story. We do not expect any meaningful power supply to come from SMRs until the 2030s, but the investments from the hyperscalers is a good signal that the technology will move forward towards commercial production in the future. We do expect that eventually SMRs will play a role in the generation stack for utilities, largely thanks to SMRs modular nature. Utilities will be able to build ~300MW of SMR capacity every 2-3 years and that SMR capacity will be added to the return profile of these companies. Our best guess is that we are at least ten years away from SMRs being commercial on any kind of meaningful scale.

Mark: Ryan, considering the history of large-scale technological advances, how might a Canadian investor with a 10+ year time horizon benefit from these trends?

Ryan: Many investors question whether the technological advancements related to artificial intelligence are simply a fad, or the start of a technology inflection point. We believe it is the latter as Robertson has mentioned. When we look at these types of market environments, the PC era lasted over 10 years from the mid-80s to the tech bubble in 2000. In that span, Microsoft and Intel generated 80% of the operating profits and generated 51,800% and 10,295% cumulative return respectively. The smartphone era lasted around 14 years, and a company like Apple generated 80% of the operating profits and generated a cumulative return of 4,711%.

Technology inflection points last decades, not months

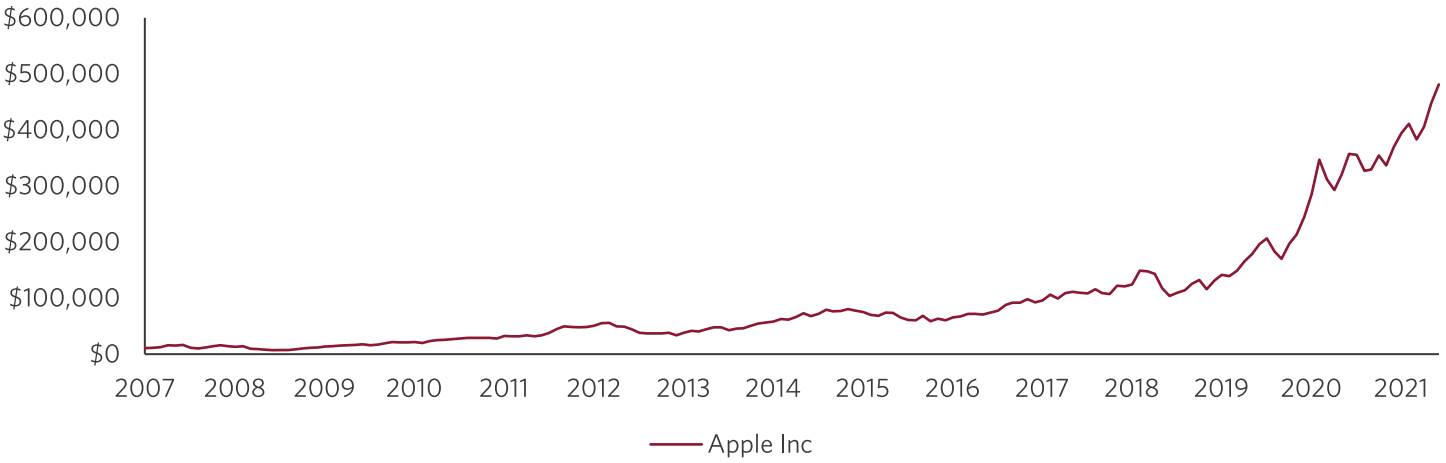
Growth of $10,000 Investment: PC Era - March 13, 1986 - March 10, 2000



Main PC Beneficiaries Company Name Cumulative Return (%)	3/14/1986 to 3/10/2000
Intel Corp	10,295%
Mircosoft Corp	51,800%

Source: Morningstar Direct, February 28, 2025.

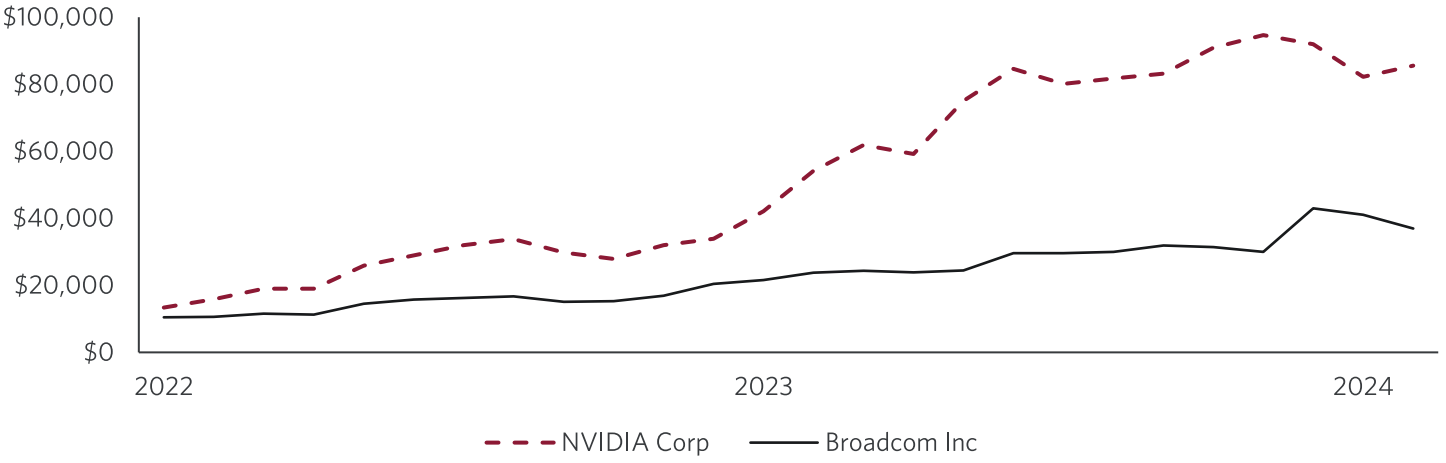
Growth of $10,000 Investment: Smartphone Era - June 29, 2007 - December 31, 2021



Main Smartphone Beneficiary Company Name Cumulative Return (%)	6/29/2007 to 12/31/2021
Apple Inc.	4,711%

Source: Morningstar Direct, February 28, 2025.

Growth of $10,000 Investment: AI Era - December 31, 2022 - ?



AI Beneficiaries Company Name Cumulative Return (%)	1/1/2023 to 1/31/2025
NVIDIA Corp	722%
Broadcom Corp	310%

Source: Morningstar Direct, February 28, 2025.

Technology inflection points can be measured in years, not months, and we recommend investors gain exposure to capitalize on the opportunity. We typically advocate for a "core and explore" approach for gaining exposure to large-scale technological advances. Many investors will have some level of technology exposure in a balanced or core portfolio. To enhance their growth profile, we recommend adding technology or innovation related investments as satellite positions. For such investors, we typically suggest a 10% allocation to innovation depending on their risk tolerance. For these types of allocations, CIBC Asset Management offers both the CIBC Technology Innovation Fund and the Renaissance Global Innovation Fund. The CIBC Technology Innovation Fund is a pure-play technology allocation, while the Renaissance Global Innovation Fund has a 60% technology, 40% health care allocation, capturing the most compelling areas of innovation globally.

For those interested in increasing exposure to the energy and resources themes mentioned, we have a number of portfolios at CIBC Asset Management that provide exposure to the Canadian Energy and Resources sectors.

Craig Jerusalim, our longest tenured equity portfolio manager at CIBC Asset Management manages multiple diversified Canadian portfolios such as the Renaissance Canadian Growth Fund. As at February 28, 2025, he has approximately 27% of his portfolio allocated to Canadian energy, materials, and utilities companies. This exposure is similar to his allocation to within the CIBC Imperial Equity High Income Pool, and the CIBC Imperial Canadian Dividend Income Pool, both components of the CIBC Personal Portfolio Services portfolios. As well, the CIBC Smart Investment Solutions portfolios have varying allocations to the Renaissance Canadian Growth Fund. Dan, Leo, and Fabio's ideas within each sector help contribute to the overall portfolio.

For those looking for more direct exposure, we offer the CIBC Energy Fund, CIBC Canadian Resources Fund, and CIBC Precious Metals Fund. Managed by Daniel Greenspan, with support from Leo Han and Fabio Serpa, these funds are comprised entirely of high-quality energy and resource related companies. The team invests in securities of Canadian companies involved in areas such as copper, uranium, natural gas, energy producers, gold among other themes. Their goal is to understand key short and long-term supply and demand drivers, look for broad themes and secular issues not yet appreciated by the market that may impact resource prices, and then perform company specific analysis to determine the best opportunities within each industry. We believe Canadian energy and resource companies are an attractive investment over the long-term given all of the compelling themes mentioned.

Mark: Thank you Ryan, Leo, Fabio, Dan and Robertson for participating in today's discussion.

Robertson Velez
Portfolio Manager

Leo Han
Senior Equity Analyst

Daniel Greenspan
Senior Analyst and Portfolio Manager

Ryan Diamant
Client Portfolio Manager

Fabio Serpa
Senior Equity Analyst

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