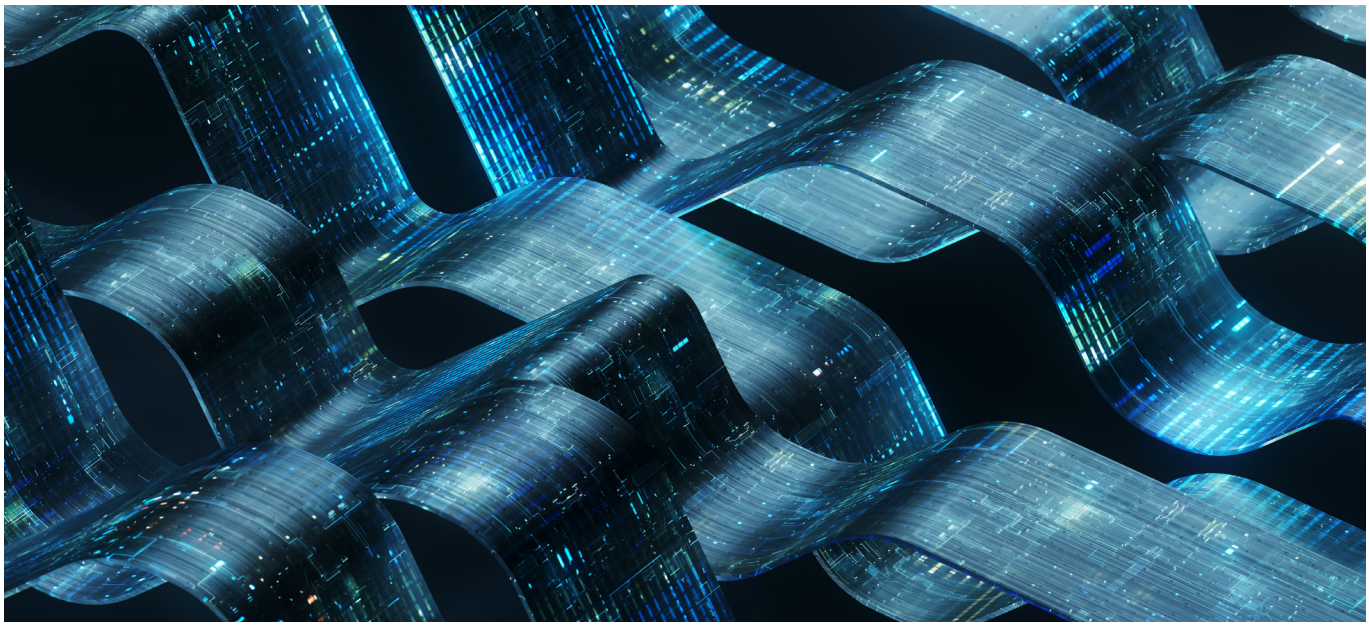

Powering AI

An opportunity for investors?

Hamish Chamberlayne

Power availability is the biggest challenge for artificial intelligence (AI) growth. The power demands of AI, combined with the impacts of reindustrialisation, electric vehicles (EVs), and the transition to renewable energy, sees the technology represent a significant investment opportunity across the entire value chain, including data centre and grid infrastructure.

However, it is important to consider potential risks, particularly the physical limitations on AI's growth, where its insatiable thirst for energy will come from, and how its associated emissions may fuel new climate concerns.

What is enabling AI?

The advancement of AI is primarily enabled by US-based chipmaker Nvidia's increasingly efficient graphic processing units (GPUs).

Currently, to train OpenAI's ChatGPT-4 in just 10 days, one would need 10,000 of Nvidia's Blackwell GPUs costing roughly US$400 million. In contrast, as little as six years ago, training such a large language model (LLM) would have required millions of the older type of GPUs to do the same job. In fact, it would have required over six million of Nvidia-developed Volta GPUs at a cost of US$61.5 billion—making it prohibitively expensive.

This differential underscores not only the substantial cost associated with Blackwell's predecessors but also the enormous energy requirements for 'training' LLMs like ChatGPT-4.

Previously, the energy cost alone for training such an LLM could reach as much as US$140 million, rendering the process economically unviable. The significant leap in the computing efficiency of these chips, particularly in terms of power efficiency, however, has now made it economically feasible to train LLMs.

The sting in the tail

Although we often assess the cost-effectiveness of these chips in terms of computing power per unit of energy—floating-point operations per second (FLOPS) per watt—it is important to note that the newer chips come with a higher power rating. This means that, in absolute terms, these new chips consume more power than their predecessors.

Couple this with Nvidia's strong sales growth, indicating an incredible demand for computing power from companies like Alphabet (Google), OpenAI, Microsoft and Meta, driven by the ever-increasing size of datasets to develop AI technologies, the power implications of AI's rapid expansion have begun to raise eyebrows.

Interestingly, thanks to efficiency improvements, global data centre power consumption has remained relatively constant over the past decade, despite a massive twelvefold increase in internet traffic and an eightfold rise in data centre workloads. An International Energy Agency (IEA) report highlighted how data centres consumed an estimated 460 terawatt-hours (TWh) [one terawatt equals one trillion

watts of power consumed over one hour] in 2022, representing roughly 2% of global energy demand, which was largely the same level as it was in 2010.

However, with the advent of AI and its thirst for energy, data centre energy consumption is set to surge. In fact, the IEA estimates that data centres' total electricity consumption could more than double to reach over 1,000 TWh in 2026—roughly equivalent to the electricity consumption of Japan.

This highlights how demand for AI is creating a paradigm shift in power demand growth. Since the Global Financial Crisis (GFC), demand for electricity in the US has witnessed a flat 1% bump annually—until recently.

Driven by AI, increasing manufacturing/industrial production and broader electrification trends, US electricity demand is expected to grow 2.4% annually. Further, based on analysis of available disclosures from technology companies, public data centre providers and utilities, and data from the Environmental Investigation Agency, Barclays Research estimates that data centres account for 3.5% of US electricity consumption today. Further, data centre electricity use could be above 5.5% in 2027 and more than 9% by 2030.

Critical questions

A historical barrier to AI development has been energy costs. Considering prevailing trends and their power implications, a crucial question arises: Where is this additional power going to come from and what are the implications for emissions?

In exploring this issue, three key areas emerge as focal points:

1. *Electrification value chain*
2. *Physical constraints*
3. *Emissions profile*

To address these issues, the major hyperscalers [large-scale cloud computing and data management service providers for organisations requiring substantial data infrastructure] have restated their commitments to decarbonisation pathways and some have turned towards nuclear energy as a solution, but this brings its own environmental considerations. We must consider the emissions profile of AI and the broader environmental impact of increased power consumption. This includes not just the immediate emissions from power generation but also its long-term sustainability.

The emissions profiles of big tech companies have barely declined over the last several years, with the rise of AI creating even larger energy demands. According to research by AI startup Hugging Face and Carnegie Mellon University, using generative AI to create a single image takes as much energy as fully charging a smartphone.

Powering the future

We engaged with Microsoft on its increase in emissions and commitment to renewable energy sourcing for data centres. In August, we were pleased to see Microsoft address concerns regarding the increasing energy requirements of AI and the resulting shift towards sustainable practices across the industry during its presentation to the Australian Senate Select Committee on Adopting Artificial Intelligence.

The hyperscaler acknowledged that AI models and related services require a lot more power than traditional cloud services and was a key issue the industry needed to address. Microsoft also stated that it remained on course to achieve its 2030 net-zero and water-positive targets in its sustainability strategy. While the increased power demands were unknown in 2020 when the targets were set, the use of renewable and nuclear energy should enable the commitment to be met sustainably.

Microsoft founder Bill Gates has urged global policymakers to refrain from going "overboard" regarding their concerns about AI's energy footprint, noting that the technology will likely play a decisive role in achieving net-zero ambitions by reducing global demand.

AI and the energy transition

Advancements in AI, when paired with innovations in renewables, may hold the key to sustainably meeting rising energy demand. The IEA reported that power sector investment in solar photovoltaic (PV) technology [to convert light into electricity] is projected to exceed US$500 billion in 2024, surpassing all other generation sources combined. By integrating AI into various solar energy applications, such as using technology to analyse meteorological data to produce more accurate weather forecasts, intermittent energy supply can be mitigated.

Researchers are also relying on AI to accelerate innovation in energy storage systems, given existing conventional lithium batteries are unable to fulfil efficiency and capacity requirements. While AI will create additional demand for energy, it also has the potential to solve challenges related to net-zero transition.

Beyond the grid, AI has the potential to play a significant role in supporting a variety of applications that can contribute to the development of a fair, clean energy economy, the U.S. Department of Energy (DOE) noted. Achieving a net-zero greenhouse gas (GHG) emissions target throughout the economy involves overcoming distinct challenges in various sectors, such as transportation, buildings, industry, and agriculture.

We are witnessing signs of growing demand for AI across various sectors including healthcare, transportation, finance, and industry; and anticipate this to be a sustained, long-term trend.

While we anticipate a short-term rise in emissions, we are optimistic that AI will ultimately contribute positively to decarbonisation efforts through innovation and productivity enhancements, and are confident that the heightened demand for power will be addressed by increased investment in clean energy.

Despite this being a year marked by significant political changes worldwide, our outlook for investing in sustainable equities remains positive. Inflationary pressures are easing, and monetary policy appears to be taking a more supportive direction. Regardless of the political landscape, the fundamental trends we are focused on are continuing to advance and develop. **FS**

Hamish Chamberlayne, Janus Henderson Investors

Hamish is head of global sustainable equities and a portfolio manager at Janus Henderson Investors. He was an investment manager with the firm from 2012, joining as an investment analyst in 2011. Previously, he was an equity analyst at Gartmore. Prior to this, Hamish worked as a senior auditor at Pricewaterhouse-Coopers, covering a variety of sectors, including energy, technology, and communications. Hamish holds the CFA designation, is a qualified accountant, and has 21 years' financial industry experience.