"There is simply not enough energy right now to run new generative AI services"

Andy Jassy, CEO Amazon, 1st June, 2024

What can halt AI's momentum?

Considering AI's recent market performance, critical questions are emerging: Is this a bubble? Where is the tangible return on investment (ROI)?

These questions are justified, considering that the "magnificent seven" technology stocks have seen their market capitalisations surge by over $7 trillion since ChatGPT's debut - a rise fuelled by what some might call unbridled optimism.

Interestingly, the most significant looming threat to AI's continued growth - acknowledged by industry titans such as Sam Altman, Bill Gates, and Mark Zuckerberg - is **energy** constraints LINK.

Two global phenomena - **climate change** and **AI** - stand at a crossroad, poised to become either allies or adversaries.

As the world transitions from fossil fuels towards renewable energy sources, it faces a significant challenge: **providing baseload power** - the ability to supply energy when renewable sources are unavailable, such as during periods without wind or sunlight.

Recently, **Peter Dutton**, Australia's federal opposition leader, rekindled the discussion on nuclear energy. This could represent an opportunity for Australia that extends beyond merely reducing energy costs and carbon emissions. **Nuclear energy** might emerge as the only viable baseload power source capable of sustaining AI's growth trajectory – globally.

Australia's potential in this arena is substantial. Not only does the country boast abundant sunshine and wind resources, but it also holds the world's largest estimated recoverable **uranium** reserves. According to the OECD Nuclear Energy Agency, Australia's reserves stand at a staggering 2,049,400 tonnes - approximately 2.5 times that of Kazakhstan, the next largest holder.

This is not to suggest that nuclear power is the definitive solution; battery storage remains a strong contender but has a higher Levelised Cost of Energy (LCOE) than nuclear. Given Australia's unique position, nuclear energy is an option that warrants serious consideration in the national energy debate.

Previous Newsletters, including this one, are available on our site in pdf HERE

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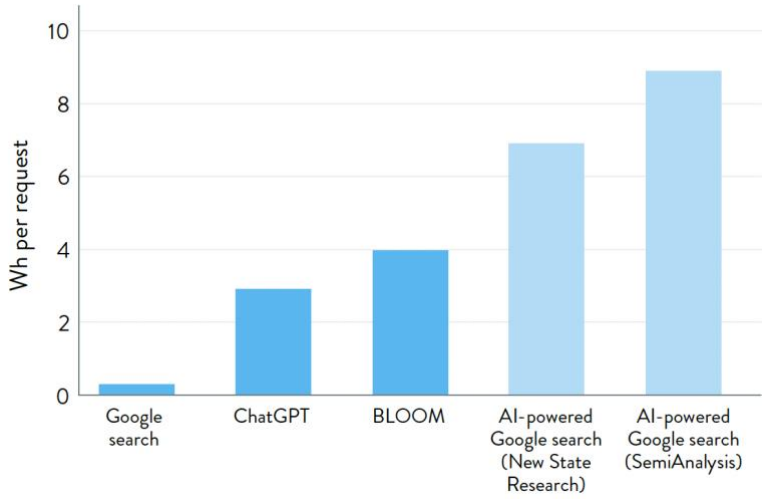
Australia's Nuclear Opportunity to Power Global AI

Artificial Intelligence (AI) is undeniably the most significant technological transition of our time, reshaping industries and economies worldwide. The global AI market is experiencing unprecedented growth, with projections indicating a compound annual growth rate (CAGR) of 37.3% from 2023 to 2030, potentially reaching a market value of USD 1,811.8 billion by 2030 LINK. In Australia, the AI sector is expected to contribute up to AUD 315 billion to the economy by 2028 LINK.

Globally, private investment in AI reached USD 91.9 billion in 2022, more than double the amount in 2020 LINK. In Australia, AI-related venture capital deals increased by 22% in 2022, reaching AUD 308 million LINK.

Complication: However, this AI revolution comes with a significant challenge: its voracious appetite for energy. For example, Google's AI-powered search, called AI Overviews, may increase the average consumption by 30 times that of a standard query – see diagram below LINK.

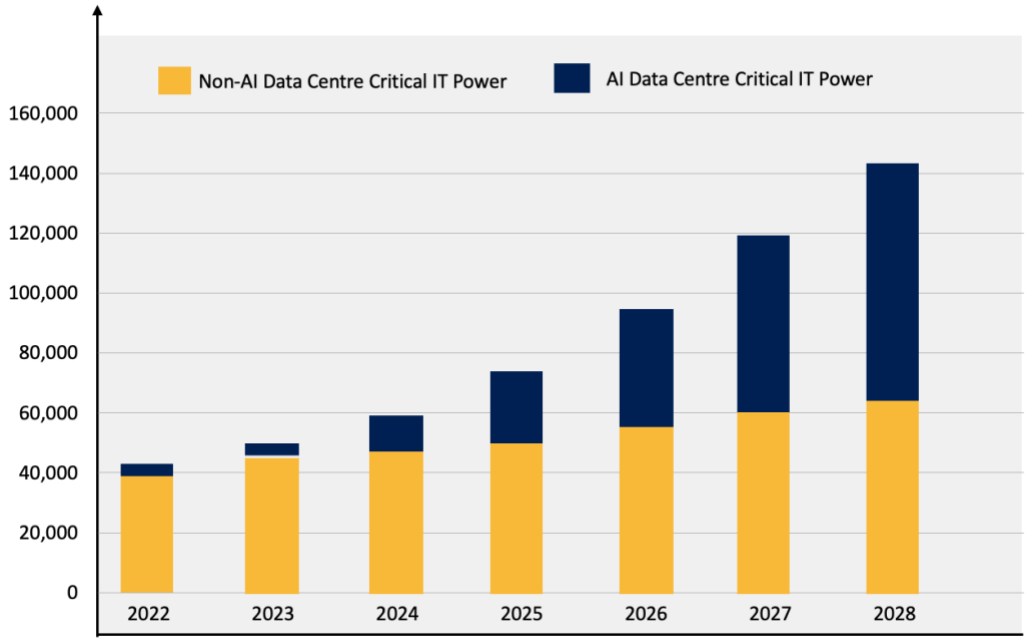


AI-powered search can use almost 30 times the power of a simple search LINK

In other words, traditional data centres are about to receive many requests 10-30 times more energy-demanding than those they were originally designed for.

"Google's emissions have risen by nearly 50% since 2019" LINK

The global IT sector, including data centres and networks that power AI, already accounts for 2-3% of global electricity consumption, with projections suggesting this could rise to 8% by 2030 – see diagram below.



Global Data Centre Critical IT Power (Megawatts MW)
Source: SemiAnalysis

This surge in energy demand coincides with a global push to reduce carbon emissions and combat climate change. Australia has committed to reducing greenhouse gas emissions by 43% below 2005 levels by 2030 and achieving net zero emissions by 2050.

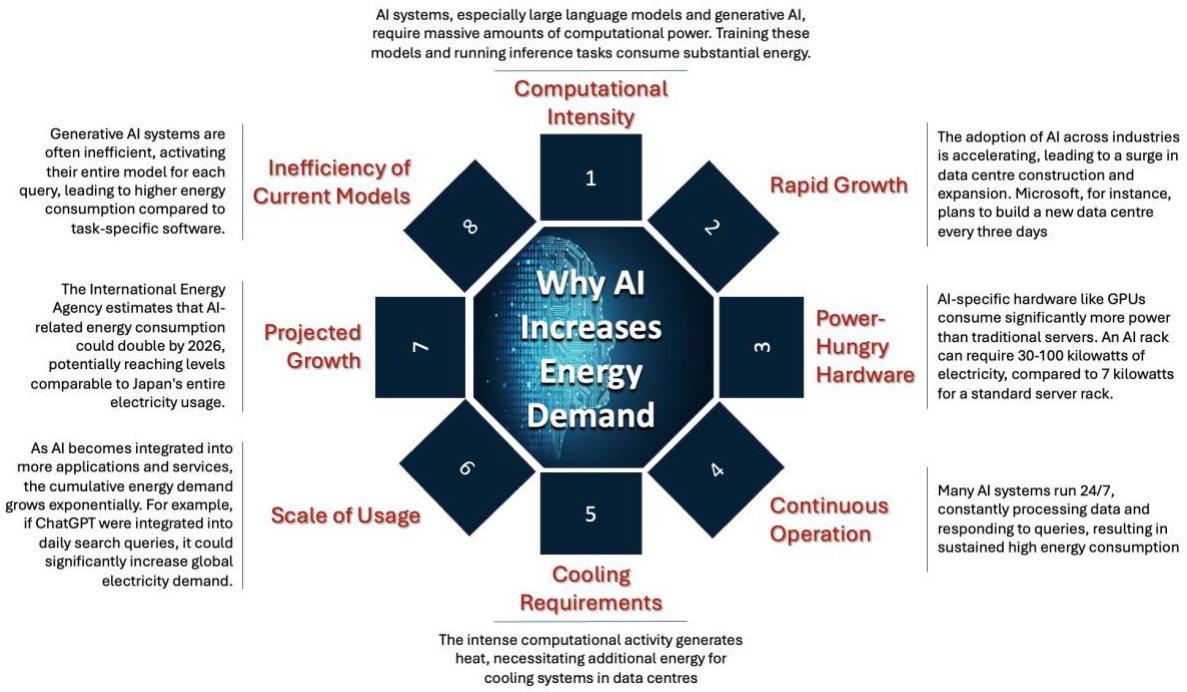
This commitment necessitates a shift away from carbon-intensive energy sources that have traditionally powered our technological advancements.

Renewable energy sources like solar and wind offer a promising alternative, with Australia's renewable energy generation increasing by 24% in 2022. However, these sources face inherent limitations due to their intermittent nature and the challenges of building new transmission. This variability poses a significant challenge for the constant, high-power demands of AI infrastructure.

Renewable advocates argue that this can be addressed by **battery storage**, however as discussed below, battery storage has its own set of challenges.

An often-forgotten factor regarding new renewable energy generators, is the **cost of new transmission lines** required to deliver power from them, often located in remote locations including sea and desert.

By proposing to install nuclear power generators in the same locations as existing coal-power generators, the federal opposition is addressing the high cost of building new transmission lines (and delays), by using existing ones - a lesson learned in the construction of the nbn.



There are eight key reasons why AI increases energy demand

Implication: We find ourselves at a critical juncture. The need for AI capabilities is undeniable, driving innovation and economic growth. However, the energy demands of AI threaten to undermine our climate goals if we rely on traditional carbon-based energy sources. While renewable energy offers a partial solution, its intermittency cannot guarantee the consistent power supply required for AI operations.

This dilemma implies a pressing need for reliable, scalable, and clean energy sources that can meet the growing demands of AI while aligning with our climate objectives.

Position: Given the current trajectory, we can reasonably assume that AI demand will continue to increase exponentially. While advancements in AI efficiency may mitigate some energy concerns, it's unlikely that software or hardware improvements alone will sufficiently offset the growing energy demands. In any case, we cannot gamble our energy future on something not yet discovered.

While proponents of renewable energy suggest **battery storage** as a solution to intermittency, as we show below, large-scale energy storage comes with its own set of challenges.

Given these constraints, we must look towards alternative clean energy sources that can provide reliable, scalable power to meet AI's growing demands. Two promising candidates emerge: **hydrogen and nuclear energy**.

Both hydrogen and nuclear energy hold promise for powering the future of AI. However, a thorough review of their safety and cost considerations is critical. *Storage and the status of hydrogen and nuclear energy production are discussed below.*

Australian Benefits: By proactively addressing the energy challenges of AI through hydrogen and nuclear options, Australia stands to gain significant benefits:

- *Global Leadership*: Australia can position itself as a global leader in powering sustainable AI infrastructure, attracting international investment and talent.
- *Economic Growth*: The development of hydrogen and nuclear industries could create thousands of new jobs and contribute billions of dollars annually to the Australian economy by 2050.
- *Energy Security*: Diversifying our energy mix with hydrogen and nuclear would enhance Australia's energy security and resilience.
- *Export Opportunities*: Australia's abundant uranium reserves (the largest globally) and potential for green hydrogen production could create significant export opportunities, with the global hydrogen market expected to reach USD 184.10 billion by 2030.
- *Climate Action*: By providing clean energy solutions for AI, Australia can significantly contribute to global efforts in combating climate change while fostering technological innovation.
- *Technological Innovation*: The synergy between AI and clean energy development could spur innovations in energy efficiency, grid management, and climate modeling.

Battery Storage

Battery storage is used to provide base load for intermittent renewable energy. While battery storage is an attractive option due to its lower operational costs and flexibility, it is not without its drawbacks.

Battery storage has several major impediments to large-scale deployment including: limited energy density, scalability challenges, raw material constraints, technological limitations, environmental concerns, regulatory hurdles, grid integration complexities, high upfront costs, long duration storage limitations and safety concerns.

LCOE: metric used to compare different methods of electricity generation on a consistent basis

According to organisations such as the International Energy Agency (IEA), the US Energy Information Administration (EIA) and others, **nuclear energy has a lower LCOE than battery storage.**

Non-Renewable Energy Sources

Non-renewable energy sources are those that do not replenish on a human timescale and can be depleted. The primary sources of non-renewable energy are fossil fuels (coal, oil, gas) and nuclear energy (uranium, thorium).

Status of Nuclear Energy

Current status: As of 2024, there are about 440 nuclear power reactors operating in 32 countries, with a combined capacity of approximately 390 GWe (gigawatt electric). These reactors provide about 10% of the world's electricity LINK.

Next 1 year: About 60 power reactors are currently under construction in 16 countries. Some of these are expected to come online in the next year, including units in China, France, India, South Korea, and other nations. LINK
Next 5 years: Approximately 90 power reactors with a total gross capacity of about 90 GWe are planned to be operational within the next 5-15 years LINK.
Next 10 years: Over 300 additional reactors are proposed beyond those currently planned LINK.

Scale and power generation: Global nuclear capacity could potentially increase by 150-200 GWe over the next decade. However, new additions will be partially offset by the retirement of older plants LINK.

Status of Hydrogen Energy

Hydrogen itself is not a primary energy source but an energy carrier. Its classification as renewable or non-renewable depends on the method of production:

1. Non-renewable Hydrogen Production: Produced from either natural gas or coal – both of which produce high CO2 emissions.
2. Renewable Hydrogen Production: Produced through electrolysis using renewable energy sources such as wind, solar, or hydroelectric power. This method splits water into hydrogen and oxygen, with no CO2 emissions.

Therefore, hydrogen can be part of both renewable and non-renewable energy systems, depending on how it is produced.

Current status: The global hydrogen market was valued at USD 228.4 billion in 2022 and is growing rapidly.

Next 1 year LINK**:** The clean hydrogen sector is expected to see increased activity globally, driven by maturing policies in Europe and the US.
Next 5 years LINK: The hydrogen market is projected to grow at a CAGR of 7.9% from 2022 to 2032. There will be advancements in hydrogen fuel cells for heavy-duty vehicles and power generation.
Next 10 years LINK : The global hydrogen market is expected to reach USD 490.7 billion by 2032.

Scale and power generation: The global hydrogen market is projected to more than double by 2032, with North America experiencing the fastest growth.

Final Word: The need to transition from fossil fuels to renewable energy is widely acknowledged. However, it is equally important to ensure a stable base load energy supply when renewable sources are intermittent. As any investment expert would advise, diversity is essential. With Australia's abundant uranium resources and the increasing global energy demand driven by AI, it is imperative that Australia seriously considers nuclear energy as a viable option. It is too big an opportunity to let go.

Stay connected.

Kevin