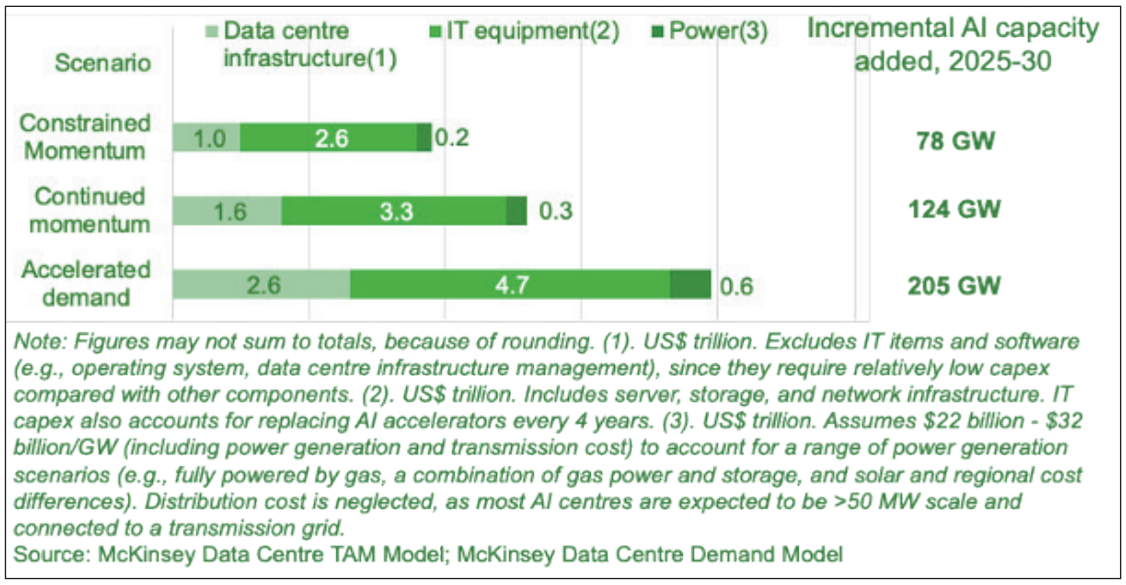
Fuelling clean tech: AI's role in global decarbonisation

The rapid rise of artificial intelligence (AI) and data centres raises a mix of concerns and opportunities. A central issue is their role in the energy transition, which raises several key questions. **Joseph Jacobelli** takes a closer look.



Global data centre capacity expenditure driven by AI by category and scenario, 2025-2030 projection ($, trillion)

Artificial Intelligence (AI) and data centres dominate the headlines almost daily, driven by both concerns and opportunities. Certainly, their role in the energy transition raises critical questions including, what is the expected electricity demand from data centres in general, and AI in particular? How will this demand be met? In which areas is data accelerating the energy transition?

AI-related data centres require a staggering amount of capital investment over the next few years. Global consultancy McKinsey calculates the amount to be between $3.7 and $7.9 trillion by 2030. The wide range is because of three scenarios, including $3.7 trillion in a constrained momentum scenario, $5.2 trillion in a continued momentum scenario, and $7.9 trillion in an accelerated demand one. Global real estate consultancy Knight Frank estimates as much as $4 trillion may be needed. An amount similar to the base case of $4.2 trillion by the International Energy Agency (IEA), which projects mid and high cases of $5.5 trillion and $5.7 trillion.

The massive investments in data centres means more electricity demand. The amount of electric power peak supply is estimated at between 78 GW and 205 GW by McKinsey, and well over 100 GW by others. The typical utilisation rate range is 40-80 per cent, translating into a total consumption by AI-related data centres of at least 274 TWh assuming 78 GW at a 40 per cent utilisation, up to 1435 TWh assuming 205 GW at an 80 per cent utilisation. Global independent assurance and risk management company DNV in its 2025 'Energy Transition Outlook' report notes that "a review of over 50 publications with recent estimates… shows a vast range in global data centre energy demand for 2030" of 210 TWh to as much as 7900 TWh at the high end. A realistic amount would be 1000-1500 TWh, between a two- and three-fold increase versus 2024.

The extra demand is unlikely to create a supply crunch. The assumption by the IEA and others is that global power demand will be about 30 000 TWh by 2030. This would mean that the consumption by data centres would only represent a modest amount of 3.3 per cent to 5 per cent. Still the incremental growth will not only happen in emerging countries, which should experience consumption at significantly higher rates than developed countries. It will also occur in developed economies such as Europe and North America.

New demand will be met by a variety of energy sources. Clean power coupled with energy storage systems are likely to take the lead. The supply should be reinforced by flexible gas fired generation. Some countries may opt to also add coal fired generation, but this is more likely to be a short-term rather than a long-term plan. Longer term the revival of nuclear energy should also play a significant role. Probably from the next decade small modular reactors (SMRs), currently an early-stage technology, especially in terms of cost, are also likely to play an important role.

Most hyperscale data centres, which have a massive cloud computing scale capacity, are located outside dense urban areas. However, smaller edge (local fast computing) and co-location (shared or rented server space) sites are found near or in urban areas. Edge and co-location facilities secure energy from the local grid. Hyperscalers rely on grid-supplied energy or secure supply from dedicated generation capacity. Investors in this capacity are commonly third-parties, not the owner and operator of the hyperscale data centre, such as Amazon, Google, or Microsoft. Tech giants will usually conclude a long term corporate power purchase agreement (CPPA) with the power plant owner, and sometimes even a shareholder in the generation facility. Whatever the financial arrangement the facility can more easily secure bank financing with the CPPA in place.

Data centres have an intimate relationship with global decarbonisation. Their operation contributes to greenhouse gas emissions, but at the same time enable significant emissions reductions across various sectors.

The carbon footprint of data centres includes electricity consumption when the grid's carbon intensity is high. They also include the embodied emissions of the information technology equipment, the construction and materials used, and cooling refrigerants and systems. Overall, a data centre's carbon footprint is typically significantly lower than an average energy intensive manufacturing facility. It is also worth highlighting that while data centres electricity load is relatively stable, AI does raise the load volatility at data centres, in terms of magnitude and frequency of peaks.

In parallel, AI-related data centres play an increasingly vital role in the global path to decarbonisation. The rapidly growing computing power is helping to accelerate the energy transition in several ways.

They are driving major advances in carbon accounting, research and development of clean energy technologies, in discovering new clean tech materials, climate modelling, and in improving industrial and urban energy efficiency. AI-related data centres are also playing a key role in optimising sectoral operations through computational modelling, predictive analytics, or real-time enhancements. Fields such as industrial processes, energy storage, policy simulation, grid management and the optimisation of data centres themselves are among those benefitting from these capabilities.

For example, US-based KoBold Metals uses AI to accelerate the discovery of critical materials, such as cobalt or lithium. It deploys an AI-powered system which integrates geoscientific data to reduce unnecessary drilling and environmental impact. Another US-based company, Climate AI, uses an AI-driven platform to generate high-resolution climate forecasts. It helps agriculture, finance and other industries adapt to climate variability, improving operational resilience and enabling proactive emissions planning. The number of large corporations using AI for decarbonisation-related applications is growing rapidly. These include ABB, Enel, Siemens, and Schneider in Europe and Alibaba, Hitachi, Mitsubishi, and PetroChina.

AI and data centres are at the heart of the energy transition. They bring both significant challenges and meaningful opportunities. Their increasing electricity demand calls for careful planning, strategic investment and thoughtful management to avoid supply strains. At the same time, their ability to accelerate decarbonisation and drive breakthroughs in clean energy innovation by enabling advanced data analysis, accelerating research and development, and improving optimisation, is undeniable. Successfully balancing growing energy needs with robust sustainability measures will be critical to harnessing AI's full potential and securing a low-carbon future.

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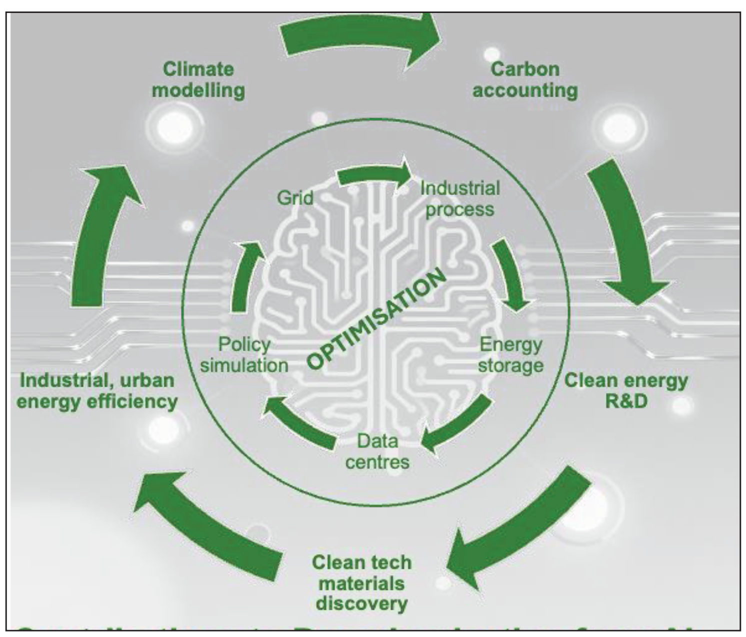
Jacobelli: Rapidly growing computing power is helping to accelerate the energy transition in several ways



Contributions to decarbonisation from AI

Source: Author, 10 October 2025. Background image: Perplexity AI, 'Black and white AI sketch with brain and circuits' (generated image, Perplexity AI, 9 October 2025)