JUNE 2025
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AI and Clean Energy: How Governments Can Unlock the Power of the "Twin Transitions"

TONY BLAIR INSTITUTE FOR GLOBAL CHANGE
ABU DHABI SUSTAINABILITY WEEK
Hosted by
MASDAR

Contents

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Executive Summary

Artificial intelligence presents both a growing challenge and an immense opportunity for the global energy transition. Both AI and energy systems are in the midst of profound transformation. On the energy side, the world is moving from a centralised, fossil-fuel-based system to one that is decentralised, digitalised and powered by clean energy. On the AI side, it is shifting from an era of narrow, niche applications to one in which AI is a general-purpose technology and a foundational piece of digital infrastructure that will underpin economic competitiveness, governance and public-service delivery. This shift is characterised by exponential growth in computing power, model complexity and deployment scale – all of which are driving unprecedented demand for energy and raising concerns about grid stability, energy availability and sustainability. While new, more efficient computing chips and AI models such as DeepSeek bring into question the scale of such projections, the technology’s broader trajectory points to significant and sustained energy implications.

At the same time, AI is emerging as a powerful enabler of the energy transition: helping optimise energy systems, manage increasingly complex grids, improve forecasting, and accelerate improved efficiency and deployment of renewables. Countries that can strategically align AI growth with clean-energy objectives will position themselves at the forefront of economic and technological leadership in the decades ahead. This is true not only for frontier, high-income countries but also particularly for fast-growing emerging-market economies, where surging energy demand, rapid urbanisation and digital transformation intersect, creating a unique opportunity to leapfrog traditional infrastructure models. The twin AI and energy transitions are therefore not just a technical or climate issue – they are a matter of national and global strategic importance.

To successfully navigate the twin transitions and harness the full potential of the AI era, governments must work with the AI industry to identify the "win-win" opportunities for both sides.

This requires creating the right policy and regulatory settings to make a country attractive for AI investment. But this investment must also help to deliver the aims of the government – delivering clean-energy infrastructure, driving energy-efficient AI deployment, and utilising AI to improve the energy system and make it faster, easier and cheaper to meet climate objectives.

This will require governments to understand the core components of the AI and energy nexus:

- Both their own strategic drivers and those of AI companies, to understand where they align and where they don't.
- The physical infrastructure needed to build compute capacity.
- The right market settings to incentivise co-investments in AI and energy technology and harness the opportunities for AI in the energy system.
- International collaboration opportunities and strategies.
- The software investments necessary to minimise energy demand.
- Frameworks for harnessing the co-benefits.

Actions that will lead the twin transitions in the right direction include: putting in place joined-up strategies that align AI and energy policy; setting clear market conditions and regulatory frameworks that attract AI investment while driving clean-energy deployment; accelerating innovation in energy-efficient AI hardware and software to reduce long-term energy demand; and ensuring emerging markets are equipped with the infrastructure, investment and institutional support needed to participate in – and benefit from – the AI era. At the global level, coordinated governance and standards will be critical to avoiding a race to the bottom and ensuring AI infrastructure supports climate, development and energy-access goals.

With AI advancing rapidly, and energy and AI policy typically siloed within governments, leaders are struggling to navigate the growing interplay between AI and its energy demands. At stake are not just national prosperity and the ability to deliver secure, affordable and clean energy, but also technological competitiveness and geopolitical influence in a world increasingly shaped by both energy and AI capabilities. Leaders are also grappling with how to design the right policies and regulations to unlock opportunities within both energy and AI while ensuring long-term resilience, sustainability and strategic autonomy.

This paper sets out the key opportunities and challenges that leaders must confront as they navigate this nexus. Its aim is to help shape a global policy agenda that advances the twin transitions and captures the broader benefits of both elements, while also providing a framework to support leaders in accelerating action – delivering smartly and strategically on this emerging priority. COP30’s Action Agenda features an item addressing these topics, underscoring the importance of prioritising this conversation now.

01

The Twin Transitions: AI and Clean Energy

The convergence of the AI revolution and the energy transition is transforming global economies. These two powerful trends are deeply interconnected and each could be a driver of the other's success: AI has the potential to accelerate the energy transition, while investments in clean technology can help expand and accelerate the development and application of AI.

The Growing Importance of Energy for AI

Computing has always required power. In the early days, computers were highly inefficient, consuming vast amounts of energy for relatively modest computational output. While computing has become more efficient over time, demand has also increased. Until now, improvements in computer-system performance have been accompanied by advancements in efficiency, mitigating unit-level energy requirements. However, the widespread adoption of computer systems and digital services has contributed to a rise in their energy consumption over the past decade, particularly in data centres, communication networks, the cryptocurrency and blockchain sector, and other digital spheres.

Today, the AI revolution is now significantly contributing to rising power demand. While data centres are becoming more efficient – the average Power Usage Effectiveness (PUE)[1] score for data centres was 2.5 in 2007, compared to 1.57 in 2021, with some data centres scoring as low as 1.1 today[2] – the demand for computing is growing more rapidly. Since 2012, the computational power used to train the largest AI models has grown 100-million-fold.[3] Ten years ago, nearly all data centres used less than 10 megawatts (MW) of power. Today, large data centres can require 100 MW of power or more.[4]

Even with the efficiency advances seen in recently launched AI systems like DeepSeek's, overall power demands will likely continue to rise as AI workloads scale and its use becomes more widespread. The combination of larger model architectures, increasing demand for AI to think and respond instantly and at scale, and expanding global adoption of AI-driven services, suggests that the energy footprint of AI will remain a critical challenge for the foreseeable future.

For instance, while the industry continues to innovate on chip efficiency, AI-specific chips are consuming more absolute power. While Nvidia's new GB200 NVL72 AI system can train and run AI models more efficiently, it consumes much more power in an absolute sense, using 120 kilowatts (kW) per rack (compared to 5 to 10 kW of power for a rack in a typical non-AI-specific data centre).[5] Even if future chips and rack configurations are more computationally efficient (as is likely), they will still consume much larger amounts of power. Some projections suggests that AI-training facilities capable of accommodating 1 to 5 gigawatts (GW) of power demand are feasible by 2030.[6]

AI's demand for power is now increasing at such a breakneck speed that energy systems and utilities cannot keep up. Countries such as Ireland, Singapore and the Netherlands have instituted moratoriums on the construction of new data centres in certain regions to limit strains on the grid.[7]

While AI is estimated to account for less than one-fifth of overall data-centre energy demand today, this share is likely to grow quickly over the next few years, with the International Energy Agency (IEA) projecting that global electricity demand from data centres could double between 2022 and 2026.[8] One industry analyst projects that data-centre energy use could triple between 2023 and 2030, with AI accounting for 90 per cent of the growth.[9] In some countries with heavy concentration of tech activity, such as Ireland, data centres and new tech could account for up to a quarter of a country's electricity use.[10] In the United States, data-centre power needs are expected to triple by 2030, rising from 3 to 4 per cent of total US power demand today to 11 to 12 per cent by the end of the decade.[11]

This is an emerging challenge for the world: generating enough energy and connecting new AI infrastructure to the grid at a pace and scale that enables rapid AI growth, in addition to addressing the increasing energy demand resulting from the electrification and wider economic development of economies around the world.

The AI Challenge – and Opportunity – for Climate Action

The exponential growth in AI-driven energy demand has led to considerable concern that AI could undermine global climate ambitions. With the widespread adoption of AI and other AI-era digital technologies such as cloud computing and the Internet of Things, the demand for data processing will continue to surge. The proliferation and application of these technologies will require more powerful computing capabilities and larger storage capacity, driving increased electricity consumption.

This is not an unjustified concern. The IEA's global projections for coal demand were adjusted upwards in late 2024, suggesting that the world won't start seeing a reduction in coal demand for a few more years yet.[12] Meanwhile, within the United States, the global front-runner for AI data-centre build-out, there is a growing demand for new gas generation to meet increasing power-consumption requirements.

The fear is that, if AI's energy need is met by fossil fuels, or if newly added clean power is used primarily to support AI infrastructure rather than decarbonising the broader economy, global emissions-reduction efforts could be slowed rather than accelerated.

But this outcome is not inevitable. In fact, driven by corporate climate commitments – particularly among the major AI hyperscalers like Microsoft, Google, Amazon and Oracle – the AI boom is becoming a powerful accelerator for clean-energy investment. These companies have set some of the most ambitious climate goals in the private sector. Google and

Microsoft, for example, are aiming to power their operations with 100 per cent carbon-free energy, 24 hours a day, seven days a week by 2030. Amazon has pledged to reach net zero by 2040.

To meet these targets, hyperscalers are increasingly investing in innovative clean-energy technologies such as advanced battery storage, small modular reactors (SMRs) and geothermal energy, and are now among the largest corporate purchasers of renewable-energy contracts. Amazon, Google, Meta, Microsoft and Apple accounted for more than 45 gigawatts (GW) of corporate renewable purchases worldwide in 2023,[13] which is more than half of the global corporate renewables market. Microsoft has agreed to back $10 billion in renewable-electricity projects with Brookfield Asset Management over five years, marking the world's largest corporate purchase of renewable energy.[14] The AI hyperscalers are also driving investments into nuclear power with landmark commitments such as Microsoft's agreement to purchase power to reopen the Pennsylvanian nuclear reactor Three Mile Island Unit 1 and Google's deal with SMR developer Kairos Power to support early demand for new nuclear technologies. Hyperscalers are also creating similar agreements to drive investments into other more novel clean technologies, like advanced geothermal, novel long-duration energy storage or nuclear fusion.

In total, tech companies, corporations and utilities are projected to spend nearly $1 trillion on capital expenditures in the coming years to support AI growth.[15] As a result, AI infrastructure, while often seen as a risk to net zero, is also becoming a major demand signal for clean power, helping scale and commercialise the next generation of zero-carbon energy solutions.

This represents a significant opportunity. For individual countries, there are opportunities to unlock vast volumes of investment in essential 21st-century infrastructure. For the world, having a group of corporate buyers who are willing to be offtakers of clean power sources at a cost premium offers an opportunity to drive innovation in clean energy, accelerate clean-energy investments in more challenging markets and power AI-driven development.

It is also possible, with the right government policy settings, that hyperscaler power demand could drive additional investments in clean power beyond those required to fulfil AI's direct need, directly helping to accelerate domestic decarbonisation.

Kenya's green data-centre development

Kenya has launched an initiative to develop a green data centre, initially planned with a capacity of 100 MW (expandable to 1 GW), in response to the growing demand for compute power. This project is part of an energy-transition strategy aimed at harnessing the 10 GW of geothermal energy available in Kenya to power sustainable digital infrastructure. Kenya has also initiated a public consultation process for its National AI Strategy, which seeks to position the country as a leading AI hub in Africa, focusing on sustainable development, economic growth and social inclusion.

The initiative integrates cloud computing and AI services to stimulate innovation, optimise energy efficiency and enhance the country's digital transformation. By utilising geothermal energy, the collaboration aims to significantly reduce Kenya's dependence on fossil fuels and lower its carbon emissions, thereby positioning the country as a leader in sustainable digital infrastructure in Africa.

In addition to the energy-investment opportunities offered by AI, its use in the energy system is helping to lower cost, enhance efficiency and speed up decarbonisation in increasingly numerous ways. These include improved weather forecasting, optimised grid operations, enhanced energy-storage management, predictive maintenance of infrastructure and improved demand-response mechanisms. AI is rapidly emerging as an answer to many of the challenges around the efficient integration of intermittent and decentralised renewable sources.

""“Angola has increased its renewable-power capacity and plans to expand that further to 9GW. AI can potentially help stabilise power supply in systems with more renewables and support smart grid development. Collaboration across governments, the private sector and academia is essential for an inclusive energy transition.”""

Dr Arlindo Carlos

SECRETARY OF STATE FOR ENERGY, MINISTRY OF ENERGY AND WATER, ANGOLA

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Co-investments in compute and clean energy can also be harnessed to drive research and development. The UK's first "AI Growth Zone" – a place-based initiative designed to accelerate the development, deployment and diffusion of AI by concentrating public and private investment in high-potential regions – will be at the UK Atomic Energy Agency's Culham campus, with the potential for some of the associated compute investment to help accelerate progress in fusion development. Based on this model, governments and industry could decide to set compute capacity aside for research institutions or local start-ups, to develop AI solutions to local climate challenges.

AI has the potential to be an accelerant of clean energy, but countries across the world will need to implement the right policy conditions to harness this opportunity and unlock the positive loop. As AI and digital solutions evolve at speed, often outpacing institutional and regulatory capacity, policymakers will need to stay closely attuned to technological developments. This means not only assessing the near-term risks and benefits of emerging applications, but actively tracking where the twin transitions are headed and adapting policies and regulations to steer innovation towards resilient, sustainable outcomes.

UNLOCKING THE TWIN TRANSITIONS IN EMERGING MARKETS AND DEVELOPING COUNTRIES

Currently, a significant portion of AI investment is concentrated in just two countries. The US and China together host nearly half of the world's graphics processing unit (GPU)-enabled cloud regions, and the US alone hosts multiple regions equipped with NVIDIA's advanced Hopper 100 (H100) GPUs, essential for training state-of-the-art AI models. In contrast, most emerging markets and developing countries (EMDCs) lack this infrastructure, resulting in "compute deserts" – countries that have limited or no public cloud AI compute access, which hinders local innovation and AI governance.

The countries that find themselves on the wrong side of this new AI and compute divide face limited access to the compute power needed to unlock AI's economic-development potential, with ripple effects for developing the skills and capacity needed in an increasingly AI-driven global economy. The divide also raises important concerns around **data security, sovereignty and privacy**, as some countries may be unable or unwilling to rely on foreign infrastructure for processing sensitive data – further reinforcing the need for locally accessible, trusted compute infrastructure.

A core barrier to compute investment in EMDCs is energy. In many of these countries, energy systems are often less developed, with less resilient generation, transmission and distribution capacity; many communities still lack access to energy and in lots of cases utilities can be insolvent. Wider macroeconomic conditions can also mean that financing energy projects is more expensive and often considered too risky by traditional investors.

This means that rather than harnessing the positive loop of the AI and energy twin transitions, many EMDCs can find it harder than developed countries to attract the necessary investment in both AI and energy infrastructure .

The result of this emerging trend could be an increasingly entrenched divide – with developed countries able to build compute rapidly and at scale, while EMDCs are left behind without the ability to build the compute required to power their AI futures, or to attract the investment boom the global data-centre industry represents.

This would demonstrate the loss of a significant opportunity to drive investment and development into parts of the world where they are most needed. AI power demand could be a strong demand signal and offtaker of power, creating investable clean-energy projects and building domestic skills and capabilities that can unlock further investment. Furthermore, a lack of compute capacity and data availability within EMDCs could slow down the development of AI-enabled solutions tailored to EMDC-specific decarbonisation challenges. There is already a shortfall in the skills and capacity required to develop and use AI solutions in developing countries and regions – especially those that are climate-vulnerable – and capacity-building support is necessary to address this.

Unlocking the positive loop between AI and clean energy to drive global climate action and economic development should be a core priority for political leaders in every country around the world today.

02

A Policy Platform to Unlock the Opportunities of the Twin Transitions

Despite growing familiarity with both the AI and energy transitions, most countries still lack a joined-up strategy for navigating their intersection. Energy and digital policy are often developed in silos, and existing governance models are too slow or fragmented to keep pace with the scale, speed and complexity of technological change. Meanwhile, competition for compute, clean power and talent is intensifying — threatening to widen global divides and lock in inefficient or unsustainable trajectories. A new playbook is required to show how every country in the world can unlock the opportunities and mitigate the risks of the twin transitions.

The AI era is already transforming the energy system. Enabled by strong strategy, policy and delivery structures, there are opportunities to align the forces of the AI revolution and the energy transition to deliver growth, prosperity and accelerated climate action.

To help leaders navigate this new challenge, the playbook must consider all the core components of making the twin transitions a success.

Understanding the Strategic Drivers

To unlock the opportunities of the twin AI-energy transition, it is essential to understand the strategic goals of both governments and AI companies.

Aligning these goals will create win-win solutions for AI growth and clean energy – and ultimately drive wider climate progress. Achieving this alignment requires identifying the key drivers behind governments and AI companies’ actions and decision-making, as well as clarifying their high-level priorities. Answers to these questions will shape how governments and companies navigate and address the other key components of the AI-energy nexus (infrastructure planning, investment strategies, international collaboration, software advancements and driving co-benefits).

FIGURE 1

Strategic drivers for the twin transitions' key players

AI companies are trying to rapidly expand compute infrastructure to keep up with AI demand while meeting their net-zero targets.

Risks and Opportunities	Questions
Risks: Competition between AI companies could become a drain on energy systems, with investments becoming even more concentrated in a few countries. Efforts to green their operations (e.g. through renewable-energy certificates) could reduce access to clean power for other consumers, delivering little net benefit to overall grid decarbonisation. **Opportunities:** AI companies could become catalysts for clean energy, supporting broader climate action globally.	How much compute will AI companies require over the next decade? What are their requirements in terms of energy access and reliability? What are their investment horizons? What are their additionality rules? What are the geographic restrictions?

Clean-energy companies and utilities are trying to rapidly expand energy infrastructure at a faster pace than usual, both to decarbonise the grid and to meet AI's growing energy demand.

Risks and Opportunities	Questions
Risks: In certain countries, clean-energy companies may be unable to deliver new generation and utilities unable to deliver new connections quickly enough, meaning AI companies turn towards fossil fuels or direct investment in other countries. **Opportunities:** AI demand could help create local clean-energy industries, create economies of scale for new clean-energy infrastructure and quicken the pace of the energy industry.	What kind of certainty of demand do clean-energy companies and utilities need to increase their investment? What do their planning cycles look like?

Governments want to attract investment in compute and clean energy for economic success while maintaining and growing a robust and efficient decarbonised energy system.

Risks and Opportunities	Questions
Risks: Governments may engage in a "race to the bottom", offering unsustainable incentives to attract AI investment. Competition may also exacerbate existing digital divides, leaving some countries out of AI-driven economic-growth and energy-transition opportunities. **Opportunities:** Governments could leverage AI investments to accelerate clean-energy deployment, modernise infrastructure and create new economic opportunities – with potential for advancing decarbonisation efforts.	Does the government want sovereign compute or access to compute? What is each government's priority for their energy system? What role do they want data centres to play? What is their approach to regulatory and market instruments for clean energy and emissions reductions (e.g. through renewable-energy certificates, offsets and other mechanisms to support additionality)? What do they want to utilise domestic compute capacity for?

Source: TBI

INFRASTRUCTURE REQUIREMENTS

The successful rollout of data centres and clean-energy infrastructure relies on the availability, alignment and speed of critical infrastructure development. AI can also support efforts towards predictive maintenance and reducing downtime of physical energy infrastructure and grids, detecting safety risks and identifying when infrastructure components will likely fail. However, misalignment between data-centre energy demands, grid capacity and broader infrastructure systems can create bottlenecks, strain energy networks and slow the adoption of clean energy. These challenges are further compounded by fragmented planning, where energy, compute and industrial infrastructure are often developed in isolation.

To unlock wider economic opportunities, countries must take a systemic and holistic approach to infrastructure planning, ensuring energy and compute infrastructure are integrated and coordinated with other industries and sectors. Critically, this also includes integration with water infrastructure – although a detailed exploration of water-related challenges is beyond the scope of this paper. Countries that can achieve this effectively and at speed will be better positioned to attract investment, strengthen energy systems and drive broader economic growth – all while supporting the clean-energy transition.

FIGURE 2

Infrastructure issues to tackle for successful twin transitions

Getting a grid connection and securing land for renewables can take many years – even though the build time for renewables and their storage is often shorter than for fossil fuels. These delays risk slowing the rollout of new data centres and could, in the short term, drive investment towards fossil fuels, which are easier to connect in constrained systems.

Risks	Questions
Risks: Grid-connection delays and slow build-out of renewables could stall data-centre projects, leading to lost investment and missed economic opportunities. In the worst-case scenario, some countries may turn to fossil fuels as a stopgap – undermining both competitiveness and climate goals. **Opportunities:** The countries that can provide rapid, reliable grid connections will win out. This will benefit countries that can a) effectively plan to locate data centres where there is spare grid capacity and b) ensure that utilities and permitting regimes are able to rapidly expand clean-energy infrastructure.	How do countries better align the mismatched timelines of grid connection and data-centre build? What role can flexible connection agreements play in bridging this gap, and what are the short- and long-term risks with over- or under-building one or the other? What governance or regulatory changes are needed to enable faster, coordinated permitting for both data centres and clean-energy sources? How can countries encourage effective siting of data centres to accelerate grid connections? How do utilities need to be regulated for load growth? Which model will create the right incentives for investment? What role does utility-ownership structure play in accelerating infrastructure delivery? Are private and listed utilities better positioned than public ones to move at pace and respond to AI-driven demand growth? What requirements can countries put in place to ensure investment in grids alongside renewables? How open are hyperscalers to going off grid, directly with clean energy? If so, what requirements are there for backup grid connections?

Data-centre demand can be a drain on the energy system.

Risks	Questions
Risks: Growing energy demand from data centres could strain energy grids, crowd out other energy needs, slow the growth of compute and exacerbate wider grid instability. **Opportunities:** Countries that stay on the front foot could ensure that data centres are more effectively integrated into the energy system to mitigate impact and potentially bring benefits to the system (e.g. grid flexibility and waste-heat recovery).	To what degree are data-centre providers willing to operate flexibly when the energy system is under stress? Is this different for different providers? How do market signals need to be structured to encourage data centres to adapt to provide demand flexibility? How do countries reward other services that data centres can offer to the energy system, e.g. supplying electricity during peak demand, supplying district heat or supporting adjacent industries like agriculture? How do countries ensure these are properly valued? How can countries encourage data centres to be sited where they have the greatest positive impact? What technological (or cost-model) advancements are needed to enable real-time load shifting and demand response?

Data centres need infrastructure beyond energy infrastructure, in particular for digital communications. Where this infrastructure exists may not always match up with where the grid connections or energy infrastructure are.

Risks	Questions
Risks: Misalignment between digital infrastructure (e.g. fibre-optic networks) and grid or energy infrastructure can create inefficiencies, slow deployment and limit opportunities for data-centre siting in optimal energy locations. **Opportunities:** Coordinated infrastructure planning can align energy systems with digital-communication networks, unlocking opportunities for data-centre deployment that benefit both AI companies and the wider economy.	What infrastructure do AI data centres need? How restricted are different data centres in terms of siting and proximity to end-users? How can governments better plan, in an integrated way, for the infrastructure AI data centres need?

AI can be utilised for effective energy management and planning to make the energy system more efficient.

Risks	Questions
Risks: Not leveraging AI could lead to continued inefficiencies, grid instability and underutilisation of renewable energy. **Opportunities:** AI can play a transformative role in energy-grid optimisation, renewable-energy forecasting, load management (peak-demand forecasting etc), and infrastructure planning – helping to reduce costs, improve efficiencies and accelerate clean-energy adoption by enabling greater integration of higher share of variable renewable energy (VRE) into grids.	What are the most impactful applications of AI for energy-grid optimisation and renewable-energy forecasting? What efficiency savings could result from this? Can they be quantified? Are there ways to encourage investment in the use of AI within the energy system, alongside investments in compute? How can digital tools (e.g. AI-based modelling) improve planning processes by identifying optimal sites, minimising project risks and enhancing systems operations through smarter operation, reduced downtime and increased asset availability? What data infrastructure and management systems are required to support AI-driven energy optimisation? How can they be scaled to ensure interoperability across grids and renewable assets?

Source: TBI

Investment and Markets

Unlocking the opportunities presented by the twin transitions requires the right investment and market settings. Large AI hyperscalers are increasingly becoming critical offtakers of renewable energy to meet their net-zero targets, creating a significant opportunity to drive clean-energy deployment. However, structural barriers such as high financing costs, regulatory hurdles, unreliable energy systems and the underpreparation of associated infrastructure, such as telecommunications and the internet, can limit these investments, particularly in EMDCs where the potential benefits are significant.

At the same time, the breakneck pace of AI development is creating pressure, prompting some companies to prioritise speed and scale over sustainability and clean-energy commitments, despite AI’s long-term potential to support decarbonisation and help address climate challenges. Aligning investment structures with energy goals is therefore essential to ensuring that the expansion of AI infrastructure becomes a catalyst – not a competitor – for clean-energy access. Understanding the right enabling conditions for investment is crucial to unlocking these opportunities and delivering equitable global benefits.

FIGURE 3

Investment opportunities and challenges

Large AI hyperscalers are becoming offtakers of renewables and clean power to meet their net-zero targets. However, getting the market settings right is essential to fully unlock this opportunity.

Risks and Opportunities	Questions
Risks: Misaligned market settings, such as unclear regulations or unattractive investment terms, could prevent hyperscalers from serving as effective offtakers for renewable projects. **Opportunities:** If market conditions – e.g. regulatory clarity, favourable power-purchase agreements (PPAs) – are designed well, hyperscalers can drive large-scale investments in clean-energy infrastructure, accelerating grid decarbonisation and enabling net-zero goals.	What are the conditions required for hyperscalers to become offtakers for renewables, both in terms of market arrangements and wider regulation? Which countries receive a lot of investment, and what are the conditions there? What innovative rules are required to create attractive conditions for compute and clean-energy investments? How can governments help structure deals for investment, while minimising public investment? Could other innovative investment arrangements make more of hyperscalers’ financing? Are private data-centre developers willing to work together? Are hyperscalers willing to work together to pool demand? To what degree are AI hyperscalers willing to allow a portion of local offtake?

AI-related energy demand is driving major new investment in clean energy, but these investments are often tailored to serve compute infrastructure.

Risks and Opportunities	Questions
Risks: Clean-energy projects developed to meet AI demand may be isolated from broader energy planning, limiting benefits to the wider economy or energy system. **Opportunities:** AI-driven investment in clean energy can be designed to also benefit non-AI consumers – supporting industrial electrification, household decarbonisation and clean-energy access for underserved regions.	How can clean-energy projects linked to AI infrastructure be designed to deliver system-wide benefits, not just power individual data centres? What incentives or planning rules can encourage oversizing or shared access to clean-energy capacity developed for AI use? How can governments ensure that new energy infrastructure supports national energy-transition goals as well as AI competitiveness?

Many EMDCs have unreliable or poorly developed grid infrastructure and/or insolvent utilities, which could hinder their ability to build compute infrastructure and harness the associated opportunities.

Risks and Opportunities	Questions
Risks: In many countries, there are structural barriers that make it hard to create bankable projects that their investment can flow into (e.g. utility is insolvent, domestic cost of capital is high). **Opportunities:** Data centres can serve as solvent offtakers, de-risking renewable-energy and grid-infrastructure investments – helping to get renewables and grid investment projects off the ground.	At what threshold does a solvent offtaker like a data centre sufficiently de-risk a renewables project enough to attract private capital? How much risk is the utility willing to take on? Do all data-centre providers have enough balance sheet to bank a 15-year contract responsibility? What are the regulatory and market settings that must be implemented to create structures where data centres can serve this function?

Where the cost of energy is high, the markets for investment are less attractive.

Risks and Opportunities	Questions
Risks: High energy costs make markets unattractive for AI data centres, limiting investment in both compute and clean-energy infrastructure. **Opportunities:** Countries that can provide reliable, low-cost energy will benefit. Part of this will be about ensuring the system is low cost, or alternatively offering attractive conditions for PPAs, long-term contracts, and other market mechanisms that provide price certainty and bankability.	How sensitive are different data-centre providers to the cost of energy? How can PPAs be structured to offer long-term price stability and competitiveness for AI infrastructure without shifting additional costs onto other consumers? What design features are needed in PPAs to minimise unintended market distortions – such as negative prices during periods of excess supply, reduced revenue for renewable generators or price spikes during peak demand?

Regulatory and market instruments for renewable energy and emission reductions, such as Renewable-Energy Certificates (RECs) and offsets, are used by companies to meet their renewable-energy and emissions goals, but it is unclear whether they drive true additionality.

Risks and Opportunities	Questions
Risks: If poorly designed, RECs could fail to deliver real outcomes in terms of additionality and investment, and become a poorly trusted mechanism. **Opportunities:** Properly structured RECs and offsets can drive measurable additional renewable-energy capacity, incentivise local grid investment and support broader decarbonisation efforts.	How can RECs and offsets be structured to ensure they drive additional renewable-energy capacity on the grid? Should offsets be treated as equivalent to direct energy investments when meeting sustainability targets, or should they be evaluated separately? What metrics or verification systems are needed to measure the real impact of RECs and offsets on decarbonisation? To what degree should RECs require local grid investments? What are the pros and cons? Are there alternative market tools or financing mechanisms that deliver stronger additionality outcomes for renewable-energy development?

AI services on the grid could improve efficiency but may require new business models.

Risks and Opportunities	Questions
Risks: Outdated energy-market designs could prevent AI services from being valued properly, stifling opportunities for adoption and further innovation. **Opportunities:** Integrating AI into the grid could reduce system costs if adequately valued in the system.	How do energy markets need to be structured to adequately value AI services? What could be the impact of system efficiency and cost of energy? What are the regulatory barriers to investment in AI on the grid?

Source: TBI

International Collaboration

International collaboration is critical to addressing the global-scale challenges of AI growth and clean-energy deployment. Without coordination, siloed data-centre development can lead to inefficiencies and a harmful race to the bottom, where countries compete by offering unsustainable incentives. This approach risks undermining long-term energy-system stability, sustainability goals and economic resilience, as short-term gains take precedence over cooperative solutions.

However, greater collaboration can unlock mutually beneficial outcomes. Coordinated cross-border agreements on AI infrastructure and energy systems can reduce costs, improve access to compute and clean energy, and drive innovation and economic growth. By supporting "cooperative competition", countries can avoid undercutting each other while harnessing shared opportunities to build integrated, low-carbon digital infrastructure that benefits regions and economies more broadly.

FIGURE 4

Approaches to international collaboration

Cross-border collaboration is essential to ensure data-centre development delivers maximum benefits for energy systems, economies and the environment.

Risks and Opportunities	Questions
Risks: Siloed data-centre development across borders creates inefficiencies, delays and missed opportunities to optimise infrastructure. **Opportunities:** Cross-border collaboration on siting, energy use and data-sharing frameworks can align data centres with renewable generation, reduce costs, maximise grid benefits and support regional digital growth.	How can cross-border frameworks identify and coordinate siting of data centres near renewable-energy sources? How can harmonised permitting processes across borders accelerate green-AI projects? What shared data-sharing protocols are needed to optimise AI operations and grid balancing across regions? Can these be used to create regional "Green AI Hubs "?

A lack of international collaboration could create a race to the bottom, where countries compete to attract AI investment by offering unsustainable incentives, undermining long-term clean energy and economic goals.

Risks and Opportunities	Questions
Risks: Uncoordinated competition may lead to continued over-reliance on fossil fuels, weakened environmental standards and fiscal strain as countries prioritise short-term compute investments. **Opportunities:** International/regional collaboration can prevent harmful competition by aligning standards for clean energy integration and incentivising responsible investment.	How can international agreements or standards prevent a race to the bottom on incentives and energy regulations? What frameworks are needed to ensure AI investments align with long-term clean-energy and economic goals? How can governments collaborate to create a level playing field for attracting AI investment without compromising sustainability targets?

Source: TBI

Impacts and Co-Benefits

While data centres generate substantial energy demand and attract investment, their economic and social benefits are often limited compared to other energy-intensive industries, as they provide fewer direct jobs or immediate value to local communities. This imbalance can lead to concerns regarding their overall contribution to regional economies. However, these limitations persist because current planning and policies often fail to align AI infrastructure with broader societal goals or prioritise opportunities for local engagement.

If managed strategically, AI investments can unlock significant co-benefits: improving energy reliability through grid reinforcements, enabling greater integration of clean-energy sources, and providing access to AI resources for education, research and innovation. Realising these benefits requires intentional policies and incentives that can ensure AI infrastructure delivers meaningful, long-term value beyond its immediate operational needs.

FIGURE 5

Co-benefits to harness and impacts to manage

Data centres offer fewer local jobs and economic benefits compared with other energy-intensive industries.

Risks and Opportunities	Questions
Risks: Data centres may contribute limited economic benefits, such as few local jobs, creating concerns over their value to host communities. **Opportunities:** Governments can leverage data-centre investments to deliver broader economic benefits, such as funding for community research, job-training programmes or supporting public infrastructure development through "compute zones".	What kind of requirements can be put in place for "compute zones' in terms of benefits to the local community? E.g. allocating compute to support public research, local universities, or public services; offering discounted access for education, skills training or small businesses; investing in local grid or broadband infrastructure; or creating community-benefit funds. How can policies ensure data-centre investments support economic development beyond direct operations?

Additional energy demand from AI could increase energy costs for other ratepayers and create connection delays for other projects critical for economic growth and for the broader energy transition - such as the electrification of industry, mobility and heat.

Risks and Opportunities	Questions
Risks: This could hurt other government priorities, slow the electrification of energy-intensive sectors and create public discontent with the AI agenda, particularly if energy costs rise for households and businesses or critical projects are deprioritised. **Opportunities:** AI investments could help fund grid upgrades and accelerate improvements in reliability and capacity –creating a better, more reliable energy system that benefits all users.	How can grid planning and reinforcement be aligned to meet AI energy demand without compromising other priorities? What policies or incentives can ensure that AI-driven investments deliver grid upgrades that benefit all consumers? How can governments balance energy access for AI infrastructure with affordability and equity for households and other industries?

The carbon footprint of AI-hardware production (chips, servers, cooling systems) is often overlooked, contributing to significant e-waste and lifecycle emissions. Developing sustainable hardware and circular economy practices can reduce emissions, extend hardware life, and lower costs.

Risks and Opportunities	Questions
Risks: The energy and materials used to produce AI hardware contribute to lifecycle emissions and create long-term waste challenges if circular economy solutions are not adopted. **Opportunities:** A new approach to sustainable hardware design as well as advanced materials and circular economy practices can reduce emissions, extend hardware life and drive innovation spillovers into other industries.	How can hardware design and manufacturing processes be made more sustainable? What circular-economy solutions can extend the lifecycle of AI hardware and reduce e-waste? What are the potential innovation spillovers from research on this?

Source: TBI

Software and Chips

The rapid growth of AI workloads and the increasing complexity of models are driving AI's energy demand. While there are significant opportunities to reduce this energy impact through software optimisation, energy-efficient AI design and hardware advancements in AI-specific chips, these practices are not yet widespread. Current incentives prioritise performance and scale over energy efficiency, which means that making both AI model development and chip design greener and leaner is often deprioritised. A lack of clear measurement frameworks and accountability mechanisms further limits the visibility into energy consumption, slowing progress toward more sustainable software practices. By addressing these challenges, AI developers, chipmakers and policymakers can unlock the economic and environmental benefits of energy-efficient models and chips, driving innovation that reduces costs.

FIGURE 6

Approaches to improve the efficiency of software and chips

The rapid growth of AI workloads and increasing model complexity are driving exponential energy demand.

Risks and Opportunities	Questions
Risks: Without action to improve energy efficiency, AI's energy demands will continue to skyrocket. A lack of focus on software efficiency may also exacerbate access barriers, leaving smaller players unable to compete. **Opportunities:** Optimising AI models, improving software design and increasing energy use transparency can significantly reduce energy demand and emissions. This can cut costs, extend access to AI resources for smaller developers, and align AI innovation with climate goals.	What strategies can optimise AI models to balance performance and energy efficiency? What is the economic benefit of greener, leaner AI? Are there economic or competitive advantages for companies that adopt energy-efficient AI practices? How can these efforts be scaled? How can energy-usage transparency across AI development (e.g. lifecycle energy audits) drive accountability?

There is a lack of standardised tools and frameworks to measure and communicate the energy impacts of AI models.

Risks and Opportunities	Questions
Risks: Without reliable metrics, companies cannot fully assess or compare the energy efficiency of their AI systems, slowing accountability and innovation in the sector. **Opportunities:** Developing standardised tools for measuring energy impacts, such as lifecycle audits or energy benchmarking frameworks, can improve transparency, drive industry accountability and encourage developers to prioritise sustainability.	What tools, metrics or benchmarks are needed to measure the energy impact of AI development? How can these tools be standardised across the industry to ensure consistency and comparability? How can energy-efficiency reporting be integrated into AI procurement and investment decisions?

Advancements in AI chips and software are accelerating model performance but also increasing absolute power consumption.

Risks and Opportunities	Questions
Risks: As AI chips become more powerful, their energy demand scales up. Without prioritising energy-efficient hardware, AI's energy demand grows unsustainably. **Opportunities:** Innovations in AI-chip architecture can significantly reduce AI's energy footprint. This can help align chip performance with sustainability goals, lower operational costs for AI-driven businesses and reduce infrastructure constraints.	What advancements in AI-chip design can reduce energy consumption while maintaining computational power? How can industry incentives be shifted to prioritise the energy-efficient development and deployment of both chips and software? What role do hardware-software co-optimisations play in reducing AI's overall power consumption? Are there policy or regulatory mechanisms that can encourage the adoption of energy-efficient AI chips and/or software?

Source: TBI

Conclusion

AI's rapid expansion is reshaping the global energy landscape, creating both a pressing challenge and a transformative opportunity. Without strategic intervention, AI's soaring energy demands risk straining grids, delaying clean-energy deployment and deepening energy inequalities. However, if harnessed effectively, AI can become a catalyst for clean energy innovation – accelerating decarbonisation, optimising grid efficiency and driving investment in renewables and advanced energy-transition technologies.

AI can quickly detect faults and disruptions in the power grid, enabling a "self-healing" grid. This means that if a fault occurs, AI can help reroute the electricity flow to minimise the impact of the failure. In California, for instance, AI-based systems are used to detect faults such as tree branches touching power lines or equipment malfunctions. These systems can automatically identify the problem and isolate it, preventing widespread outages.

This is only the start. Done right, the twin transitions can complement one another to deliver transformational global benefits. But first, there are critical issues and questions that must be addressed to ensure AI supports rather than undermines the energy transition. From aligning investment incentives to strengthening policy frameworks and global cooperation, leaders must act now to shape AI's role in the energy system. The choices made today will define whether AI drives sustainability and economic resilience or exacerbates existing challenges.

With COP30 on the horizon, and AI and climate part of its Action Agenda, the twin AI and clean-energy transitions are emerging as a defining priority. By considering both the possible benefits and the potential risks, this paper aims to lay the groundwork to ensure that AI's future is inclusive and powered by clean energy.

Endnotes

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