KPMG

AI's dual promise: Enabling positive climate outcomes and powering the energy transition

A global view of how artificial intelligence is unlocking positive climate outcomes and accelerating the energy transition

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Foreword

By 2030, AI will consume more electricity than Japan[1] yet eliminate 3–5 billion tons of CO_2.[2] That paradox represents humanity's best climate opportunity.

Over the course of my career in the energy industry, I have witnessed many periods of transformation, yet none as pivotal as the current era. Today, artificial intelligence is fundamentally reshaping the way we operate and innovate. In discussions with business leaders worldwide, a consistent theme emerges: AI is revolutionizing business processes, enabling energy executives to optimize operations beyond what was previously conceivable, driving technology leaders to reimagine business models, and empowering scientists to accelerate research at an unprecedented pace.

The most compelling aspect of this evolution is AI's profound impact across the entire climate and energy sector. While it is true that AI requires substantial energy resources, its capacity to optimize systems, drive efficiency, and foster innovation far surpasses its energy footprint. Economic opportunity and operational excellence are fully aligned, presenting a unique moment for the industry.

The scale of opportunity is significant for those organizations that act decisively. Businesses that forge strategic energy partnerships, invest in infrastructure, and make forward-looking commitments, are positioning themselves to lead for decades to come.

This report provides valuable insight into what distinguishes industry leaders. Drawing on extensive conversations with executives across the AI and energy value chain, it offers a clear roadmap for leveraging this moment into a sustainable competitive advantage.

At KPMG, we are dedicated to guiding our clients through this transformation, combining advanced technology expertise with deep sector knowledge to turn sustainability challenges into strategic opportunities.

I invite you to explore the insights in this report and consider whether your organization's current approaches are bold enough. Encourage your teams to identify and pursue untapped opportunities. By embracing this transformative moment, you can not only build smarter businesses, but you can also secure an enduring competitive advantage.

"The rise of AI represents the strongest signal for clean energy demand we have seen in decades. If harnessed wisely, it can accelerate the energy transition and climate objectives faster than policy alone ever could."

Regina Mayor
Global Head of Clients & Markets
KPMG International

[1] Energy and AI, International Energy Agency, April 2025
[2] New study finds AI could reduce global emissions annually by 3.2 to 5.4 billion tonnes of carbon dioxide equivalent by 2035, Grantham Research Institute, London School of Economics and Political Science, June 2025

Executive summary

Our global study of over 1,200 energy leaders shows that AI not only has the capacity to accelerate the clean energy transition but it also actively supports climate progress.

Artificial intelligence is moving faster than any technology in history. In just a few years, it has shifted from experimentation to becoming the engine of global productivity and innovation. Yet its rapid rise has sparked debate, can the same technology driving progress also accelerate the clean energy transition or is it going to have an adverse impact on making progress on the climate agenda? Our research shows that AI's potential climate benefits far outweigh the negative climate implications arising from the use of fossil fuels-based energy generation to power data centers and other parts of the AI revolution.

This global study explores how organizations are using AI to drive sustainability and where action must accelerate. It draws on insights from 1,202 executives across twenty markets, spanning energy producers (utilities, renewables, infrastructure developers) and major energy consumers (hyperscalers, data center operators, and technology firms).

In this report we will explore how AI is both a climate enabler and an energy transition accelerator, optimizing emissions reductions, enabling greater energy efficiency, and resilience while driving demand for clean power. The following four sections are addressed in the report:

1. AI's expanding climate handprint

AI is expanding its climate handprint, powering adaptation solutions, biodiversity protection, and circular innovation. By 2027, 62 percent of major data and AI operators expect to self-generate clean energy, investing directly in renewables.

2. AI powering clean energy transition

System-wide transformation: AI is enabling real progress on sustainability across value chains, from manufacturing and transport to agriculture and buildings, and helping to create positive value for companies who are addressing their climate risk exposures.

3. Barriers to acceleration: Closing the AI–energy transition execution gap

The execution gap: Progress is uneven particularly due to challenges in scaling clean power solutions globally. Infrastructure bottlenecks, policy delays, and financing barriers risk slowing down momentum. The next 24 months, through 2027, will be decisive in closing this gap

4. Turning barriers into advantage

Market pull for innovation: AI is growing fast and creating new markets for advanced clean technologies, reducing commercialization cycles from decades to years.

The conclusion is clear: When it comes to the climate agenda, AI is a force for good. It can help to accelerate the energy transition by optimizing renewable energy generation and distribution, making these sources more reliable and efficient and contribute to broader climate improvement through advanced data analysis for environmental monitoring, predictive modeling for climate resilience and intelligent resource management.

Who this report is for:

The key question is whether your AI strategy is accelerating your climate goals or undermining them?

This report speaks directly to the key stakeholder groups who stand at the crossroads of AI acceleration and climate responsibility. Each faces a different version of the same challenge: how to advance AI without undermining sustainability and how to use sustainability as a competitive advantage.

Hyperscalers: understand how leaders are leveraging their significant energy demand and operational scale to become active energy producers driving innovation in clean energy.

Utilities: learn how grids are transforming into intelligent, dynamic systems using AI for real-time forecasting, balancing supply and demand, and integrating intermittent renewables to meet the surging energy needs of AI workloads.

Developers: find how they hold the key to AI's clean energy future by scaling clean supply at speed, innovating in flexible generation and storage solutions with AI, and forming strategic partnerships to accelerate renewable project deployment.

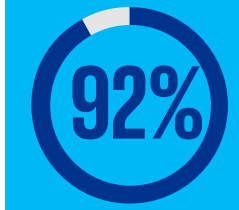
Investors: examine how to prioritize capital allocation towards integrated AI-clean energy solutions, financing cross-sector collaborations and AI-driven innovation in renewable energy.

Governments: will discover that by streamlining policy frameworks, accelerating permitting, and enabling private investment in grid infrastructure, they can unlock the full potential of AI and clean energy to drive rapid, coordinated progress toward decarbonization and climate resilience.

Contents

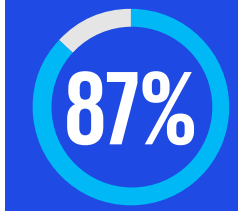
Key findings

Growing influence of AI in the energy sector



of energy producers expect greater than 10% growth in the next three years.

of energy executives describe AI as a net positive for accelerating progress towards net zero goals



say AI is central to achieving net zero goals.

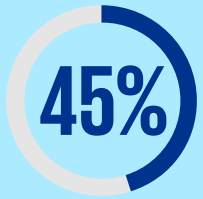
Energy demands and challenges of AI

Among data centers, AI-related energy use will jump from 8% to **36%**

Only

prioritize improving AI's own energy efficiency in the near term.

96% of executives believe clean energy can meet AI's demands, though **33%** cite grid infrastructure limitations as a top barrier.



plan to meet energy needs primarily through onsite generation.

Progress and gaps in net zero commitments

Organizations project a **4x** increase in high-renewable usage (75–100%) in just three years, from 8% today to 30%

Only

of organizations extend net zero commitments to their full value chain.

Only **13%** of energy consumers believe clean energy is non-negotiable, even if it delays projects.

Policy and regional perspectives

say policymakers have been too slow to embrace the climate benefits of AI

Executives who believe that growth and sustainability are compatible objectives:

39% ASPAC

34% Americas

27% EMA

Introduction

Artificial intelligence is advancing rapidly. In just a few short years, it has leapt from pilot projects to become the engine room of global productivity and innovation. But its rise has also struck a nerve. The same technology driving progress has become the lightning rod for a growing debate about energy use and climate impact. This report looks at this tension, where the promise of AI meets the planet's most urgent challenge and we find that the climate benefits brought by AI outweigh the negatives.

The energy reality behind the AI boom

The rise of AI has triggered an extraordinary surge in computing power, and with it, a dramatic increase in the hunger for energy. Training and running large AI models requires vast amounts of electricity, driving an explosion of data centers, which are industrial ecosystems built to process and deliver intelligence at scale. These are among the most energy-intensive facilities ever constructed.

The International Energy Agency projects that by 2030, electricity demand from data centers will more than double to around 945 terawatt-hours (TWh).[3]

Much of that increase will come from AI itself, with workloads that could quadruple energy use in just five years.

The sources powering this boom are mixed. Some hyperscalers are racing ahead, signing long-term renewable power deals and building their own clean-energy capacity. Others remain tied to grids still dominated by fossil fuels. It is this uneven progress that has ignited a public debate: that AI, for all its promise, could end up undermining the climate agenda through its growing appetite for power generated from fossil fuels.

[3] Ibid

KPMG insight

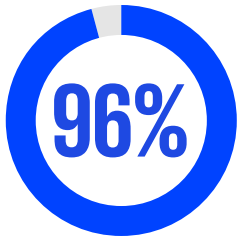
AI's transformative impact on energy and natural resources

"In my experience as Global Head of Energy, Natural Resources and Chemicals, I've witnessed numerous shifts in the energy industry. However, the current era, driven by artificial intelligence, is truly transformative. This report rightly highlights AI's dual promise: enabling positive climate outcomes while powering the energy transition. From optimizing complex operations and enhancing resource management to accelerating scientific research and reimagining business models, AI is fundamentally reshaping how we approach energy. This isn't just about technological advancement; it's about unlocking unprecedented levels of efficiency and innovation that are critical for a sustainable future. The economic opportunities and operational excellence that AI brings are perfectly aligned, presenting a unique and pivotal moment for our industry to drive meaningful change."

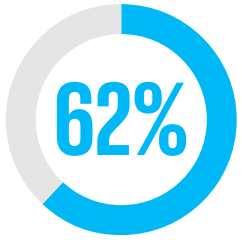
Anish De
Global Head of Energy,
Natural Resources and Chemicals
KPMG International

Three revelations from our research call for immediate attention:

of organizations extend net zero commitments to their full value chain, meaning 71 percent are optimizing for 10 percent of their true climate impact while ignoring the rest. For most businesses, up to 90 percent of their total carbon footprint lies within the value chain, primarily from suppliers.[4]



express confidence that clean energy can meet AI's demands, yet 33 percent simultaneously cite grid infrastructure limitations as a top barrier, a confidence-constraint mismatch that could derail clean power expansion plans.



of hyperscalers plan to implement self-generation energy within three years, fundamentally transforming from energy consumers to energy market-makers.

[4] Value Chain and Supply Chain Sustainability, Carbon Trust, 2025
[5] Global CEO Outlook Survey: Energy, Natural Resources & Chemicals, KPMG International, October 2025

Rethinking the narrative

The argument that AI consumes enormous amounts of energy only tells half the story. Yes, AI's energy footprint is real, but its climate handprint is far larger. AI is fast becoming one of the most powerful tools we have for accelerating climate progress. It is helping grid operators predict demand and balance renewable supply in real time. It is optimizing industrial efficiency, advancing climate modelling, cutting waste, and speeding up the deployment of clean energy amongst many other benefits that we explore in this paper.

For the first time in three decades of energy transition, the economics and the ethics are starting to align. Where the climate crisis alone struggled to mobilize enough capital and political will, AI's rapid growth is creating an economic necessity that could finally make large-scale clean-energy deployment unstoppable.

Our central argument is simple but transformative: AI isn't a threat to the climate agenda; it could be its greatest accelerator. The question is not whether AI consumes energy, but what kind of energy it consumes and how we use AI itself to decarbonize, become more adaptive and protect nature and biodiversity faster and at scale.

The KPMG 2025 CEO report highlights that energy CEOs are thinking the same way. More than four out of five CEOs in the energy sector (82 percent) believe AI can support efforts to reduce emissions and optimize energy use, and 74 percent think AI can boost their climate risk analytics, to better model future scenarios.[5]

"There appears to be limited public debate on data centers which is leading to a lack of understanding of their contribution to the total energy system. Through a narrow lens, data centers are seen as significant energy users in terms of kilowatts without the counter argument of the benefit they bring to society, in terms of digitalization of services and electrification of transport systems. The narrative needs to shift to a total energy system discussion."

Matt Kennedy
Global Head of Client Transformation
IDA Ireland

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AI's expanding climate handprint

Headlines about AI's energy "crisis" obscure a more complex truth. In this chapter we look behind the noise, quantifying AI's real footprint and exposing where AI can be one of the most powerful enablers of climate progress as a provider of insights driving innovation, growth and resilience. For executives, it provides the clarity needed to make grounded investment and policy decisions, replacing speculation with evidence.

Far from being a net drain on global resources, AI is proving to be a net contributor, helping cut emissions, optimize energy systems, and unlock entirely new routes to climate resilience and nature restoration. The question is no longer whether AI can offset its footprint, but how quickly business and government can deploy it to expand its climate handprint, the measure of its positive environmental impact.

"In Arizona, we have been working on a computational flexibility effort for a data center. By using AI technology, we are able to control the power flow to the GPUs and CPUs in that facility and bring down their peak load by 25 percent, and there is no negative impact to the output for the company or their customers. That is a big deal. Similarly, in North Carolina a data center uses an AI algorithm to reduce the load by twenty percent. Again, very successful."

David Porter
Vice President, Electrification and Sustainable Energy Strategy
EPRI

The Paris Agreement, a cornerstone of global climate action, sets ambitious targets to limit global warming. From optimizing energy grids and predicting renewable energy output to enhancing carbon capture and improving energy efficiency, AI can empower nations to achieve their Nationally Determined Contributions (NDCs). Beyond mitigation, AI strengthens climate resilience through advanced modeling and early warning systems, aligning with the Agreement's adaptation focus. Furthermore, AI can bolster the Paris Agreement's transparency framework by improving the accuracy and efficiency of emissions reporting and renewable energy deployment. Ultimately, AI serves as a powerful tool, to meet the urgent and measurable objectives outlined in this global accord.

KPMG insight

AI accelerating climate efficiency

The discussion around AI's energy footprint often overshadows its immense potential to drive climate efficiency. From my perspective in Energy Deal Advisory and Energy Transition Strategy, AI's true power lies in its ability to optimize operations, reduce waste, and enhance resource management across the entire energy value chain. This isn't merely about incremental improvements; it's about fundamentally reshaping the economic viability of sustainable practices. For organizations navigating the energy transition, leveraging AI for climate efficiency creates compelling new avenues for strategic partnerships and investment opportunities, turning environmental responsibility into a clear competitive advantage and a catalyst for impactful deals."

Wafa Jafri
Partner, Energy Deal Advisory
KPMG in the UK

Sector by sector: The proof in practice

Across the global economy, AI is already demonstrating that climate impact and commercial performance can reinforce each other.

Energy systems

In power generation and distribution, AI-enabled forecasting and grid optimization are transforming how renewable energy is integrated and managed. Grid operators such as PJM in the US now use AI to balance fluctuating supply, accelerate grid connections, and make better use of assets.[6] In our research, 97 percent of energy executives describe AI as a net positive for the low-carbon transition.

Transport

In aviation, AI's impact is visible in the sky. A collaboration between Google Research, Breakthrough Energy, and American Airlines has shown that contrail prediction models can cut heat-trapping contrails by more than 50 percent,[7] with negligible fuel penalties. On the ground, AI is optimizing freight routes, predicting maintenance before failures occur, and coordinating the rollout of autonomous electric fleets. The result: lower fuel use, fewer delays, and improved reliability.

Food and agriculture

AI-powered precision farming is helping growers use water, fertilizer, and energy far more efficiently. From drone-enabled crop monitoring to disease detection and intelligent irrigation, these systems are improving yields while reducing environmental impact, the elusive win-win long promised by agricultural technology.

Manufacturing

On factory floors, AI is rewriting the rules of efficiency. Predictive analytics prevent costly downtime. Digital twins allow engineers to evaluate carbon-reduction scenarios before committing to physical change. And across entire plants, machine-learning systems are trimming waste and lowering energy intensity.

Buildings

In commercial real estate and large campuses, AI-based control systems are delivering double-digit reductions in both energy use and operating costs. By learning how occupants actually use space, and adjusting heating, cooling, and lighting in real time, these systems make sustainability seamless.

The emerging pattern is clear: AI is becoming a system-wide optimizer, not a bolt-on technology but a coordination engine capable of reducing emissions at scale.

[6] Google deploys AI to speed up connections at PJM largest US power grid, Reuters, April 2025
[7] Google AI-based prediction study with American Airlines shows 54% reduction in aircraft contrails, GreenAir News, 2023

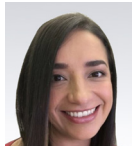
The value chain: AI's next frontier

Most corporate emissions lie beyond the organization itself, in suppliers and customers. These value-chain emissions often make up the majority of a company's carbon footprint, yet fewer than a third of businesses include them in their climate targets.

AI offers a way to close that gap. By creating an intelligence layer that connects suppliers, producers, distributors, and consumers, AI can enable real-time emissions tracking, demand synchronization, and waste reduction across the chain.

Companies are already using AI-driven analytics to redesign logistics networks, forecast demand more precisely, and guide suppliers toward lower-carbon materials. The outcome is a more transparent, resilient, and cost-efficient ecosystem, one where sustainability strengthens, rather than complicates, profitability. As the chart on the following page shows, respondents believe that AI driven statistics can help drive improvements in carbon accounting, emissions tracking and energy utilization.

"We shouldn't look at it as an isolated variable of all of the energy that is being consumed, but it is a complete equation. Where it is not just AI is a consumer of energy, but AI is a driver of energy innovation and innovative use cases that are bringing efficiency as well. We need to zoom out and look at the entire picture."



Yina Arenas
Corporate Vice President
Microsoft Azure AI Foundry

"AI changes how you design digital twins. The way that it was done before, using physical equations, physical models, biological models or even 3D models of installations is no longer enough, you now need to think of it with an AI layer that helps speed up optimization or simulations, or predictive capabilities of these models so that you can then use them through the value chain and through the life cycle of energy projects."

Mihir Sarkar
Head of AI
Engie Research & Innovation

Case study

Aramco — Turning data into decarbonization

Few examples illustrate the dual benefit potential of AI, operational and environmental, more clearly than Aramco.

The company is embedding AI across its value chain, from exploration to logistics. It has proposed an Autonomous Drilling Hub: a centralized command center that connects drilling operations worldwide, using live data streams to improve decision-making and reduce the need for carbon-intensive exploratory wells.

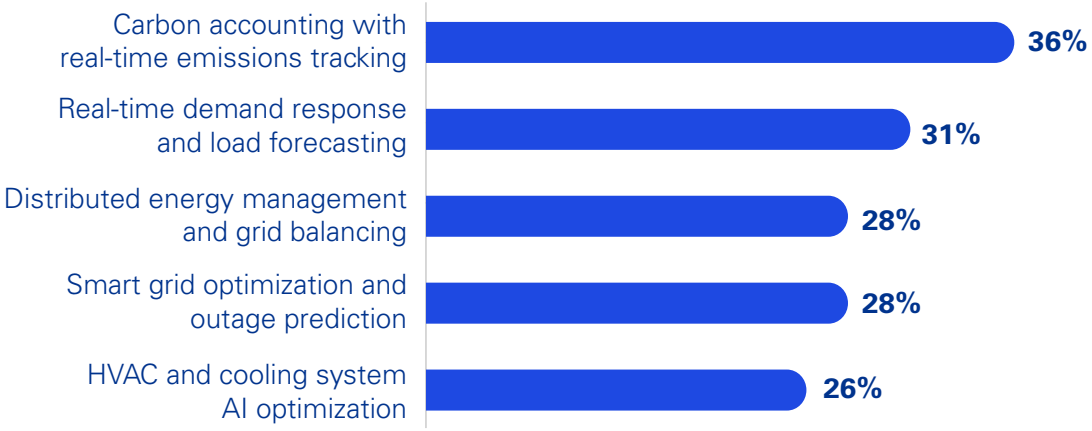
Through its digital subsidiary, Aramco Digital Company, AI is used for predictive maintenance on rigs and pipelines. The business impact is obvious and, fewer breakdowns and lower costs, but the environmental payoff is just as significant. Predictive systems minimize flaring, detect methane leaks early, and make operations safer and cleaner.

AI's reach within Aramco extends even to maritime logistics. Early pilots have used optimization models to refine tanker routes, cutting voyage time, fuel use, and emissions. Similar models could eventually coordinate entire global supply chains. Even demand forecasting is being reimagined: AI systems can now align production more closely with real market needs, reducing overproduction and the emissions tied to storage and distribution.

Aramco's experience illustrates a wider point: AI is not just a sustainability tool, it is a competitiveness tool. If AI can reduce emissions and increase efficiency in oil and gas, it can do so in any industry.[8]

[8] How AI helps Aramco turn old data into new opportunity, Aramco, March 2025

Role AI can play to deliver positive climate outcomes



The KPMG research in Optimizing Output, Minimizing Footprint[9] shows this clearly: AI-powered processes running on renewable grids emit substantially less carbon than manual operations powered by fossil fuels. Cost efficiency and sustainability, once seen as competing goals, now advance together.

Addressing value-chain (Scope 3) emissions is fast becoming the next frontier of decarbonization. Some sectors are already moving decisively in this direction as they now plan to work exclusively with supply-chain partners that meet the highest ESG standards. This kind of upstream pressure, when combined with AI-enabled transparency and coordination, has the potential to accelerate decarbonization far beyond a company's direct operations. Our research shows that AI can function as the intelligence layer that connects, and greens, entire supplier networks.

For early adopters, the advantage runs deeper than process efficiency. Integrated ecosystem intelligence, the ability to see, sense, and optimize across the entire value chain, is difficult to copy. It becomes a structural competitive edge.

[9] Optimizing output minimizing footprint, KPMG US, May 2025

Organizational commitment to carbon reduction

We have a net zero science-based target commitment to reduce emissions across our entire value chain **29%**

We have a net zero science-based target commitment to reduce emissions in our own operations **26%**

We have made a public commitment to reduce emissions spanning the entire value chain **16%**

We have made a public commitment to reduce emissions from our own operations, but not emissions spanning the entire value chain **9%**

It should be recognized that the existence of data centers powered from fossil fuels generated sources is resulting in considerable Scope 3 challenges for corporates — this in turn is helping to generate greater focus on the importance of scaling renewable energy so that these corporates can meet their net zero commitments. However, less than one third of the organizations surveyed have developed commitments to reduce carbon emissions across the entire value chain.

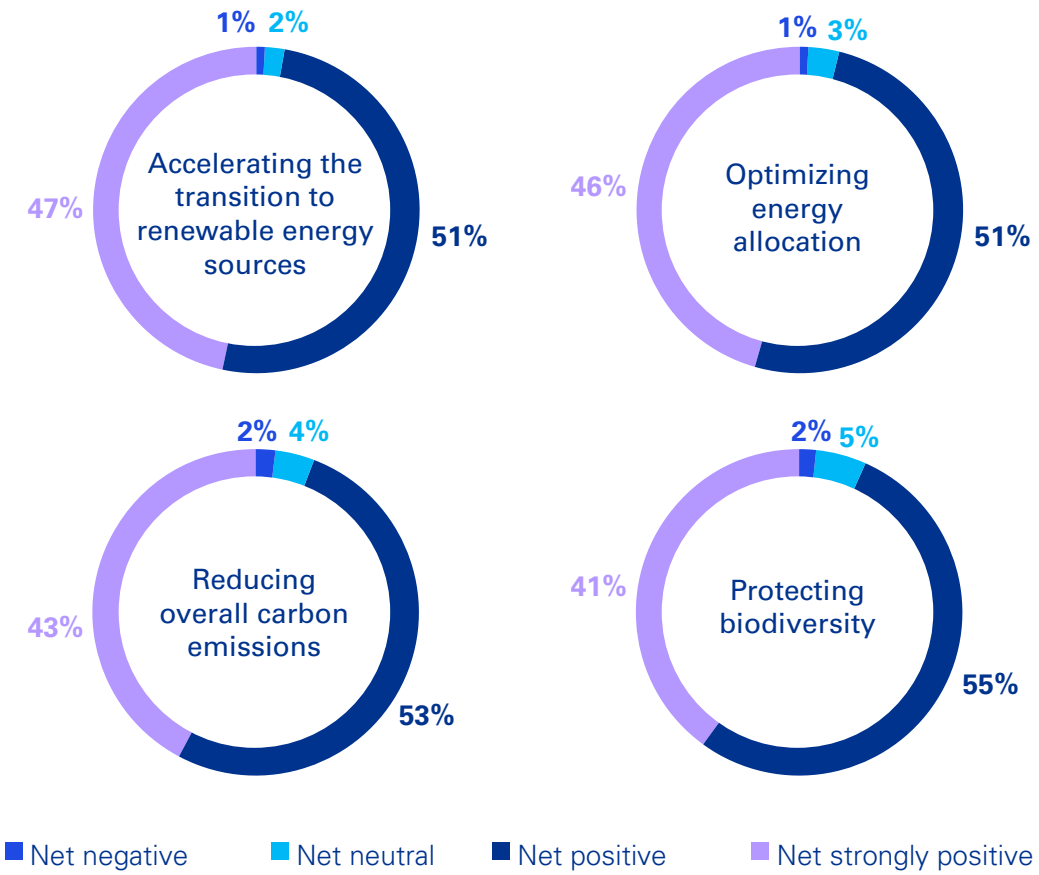
Beyond decarbonization: AI and the broader climate agenda

AI's influence now stretches into the wider fields of climate adaptation, biodiversity, and circular-economy innovation.

- **Adaptation and resilience:** AI models are improving climate forecasting and early warning systems, enabling faster disaster responses and smarter infrastructure planning. Insurers and infrastructure operators are embedding these insights into risk assessments and capital allocation decisions.
- **Nature and biodiversity:** Ninety-six percent of executives in our study report positive results from AI-driven biodiversity initiatives. AI now analyzes satellite and acoustic data to detect deforestation, poaching, and species decline as they happen, giving conservation teams precious time to act.
- **Circularity and materials science:** At MIT, machine learning has reviewed more than 88,000 studies to identify new substitutes for clinker in cement, one of the most carbon-intensive materials on earth.[10] Similar breakthroughs are emerging in metals, polymers, and battery chemistry, driven by AI-assisted discovery pipelines that dramatically shorten innovation cycles.

[10] MIT Researchers Use Machine Learning to Identify Sustainable Alternatives to Cement Production. AZoBuild, August 2025

Impact of AI on different aspects of the climate agenda



AI and circular solutions (water and heat)

AI's energy demand attracts the headlines, but water use is becoming just as critical. Training large models consumes vast amounts of water for cooling and power generation. By 2027, global AI systems could require between 4.2 and 6.6 billion cubic meters of water annually, several times Denmark's total yearly consumption.[11]

Forward-thinking operators are already adapting. Many are locating data centers in areas with abundant renewable energy and sustainable water supplies, while others are investing in closed-loop cooling systems that capture and reuse waste heat for district heating or industrial use. These innovations can reduce operating costs by up to 25 percent and turn waste into an asset.

"Data centers bring significant economic opportunities and our conversations with customers often focus on how we collectively engage communities and demonstrate social value. We have some great examples of community engagement in SSE such as taking surplus heat from data centers and redistributing to hospitals and schools."

Nikki Flanders
Managing Director
SSE Energy Customer Solutions

[11] Making AI Less Thirsty: Uncovering and Addressing the Secret Water Footprint of AI Models, Arxiv, March 2025

Case study

Meta surplus heat from a data centre in Odense

In Denmark, hyperscale facilities produce significant amounts of waste heat, energy that has traditionally gone unused. As Denmark accelerates its green transition and plans to phase out coal-fired heat, finding ways to capture and reuse this surplus energy has become a national priority.

To address this challenge, Fjernvarme Fyn, Denmark's third-largest district heating company, established the Tietgenbyen Energy Centre, the country's largest heat pump installation. The facility captures approximately 215,000 MWh of surplus energy annually from Meta's Tietgenbyen data centre in Odense. Using an innovative water-based circuit, surplus heat is transferred from the data centre to adjacent ammonia-based heat pumps that raise the temperature to 70–75°C, making it suitable for the city's district heating network.

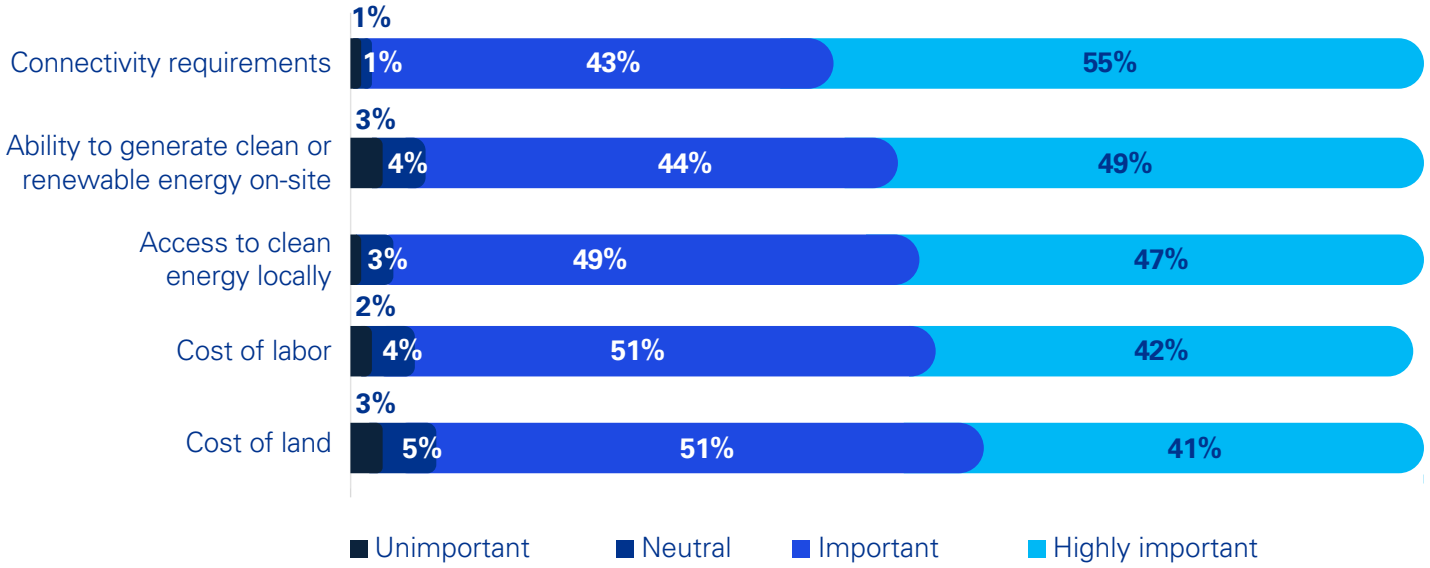
The project delivers heat to more than 12,000 homes, cutting Odense's reliance on coal and supporting Fjernvarme Fyn's ambition to achieve 100 percent renewable energy by 2030. With a total heat production capacity of around 45 MW, it represents Denmark's largest-scale example of industrial heat recovery.

Denmark's energy sector is evolving to support industrial heat reuse. As a result, 63 percent of Danish data centres now plan to integrate waste-heat recovery, marking a major step toward a cleaner, more circular energy system.[12]

[12] Largest Danish heat pump installation utilising surplus heat from data centre, Ramboll, 2019

All of these issues have a major influence on the location of data centers.

Important factors in location choice for data centers and hyperscalers



As resource constraints tighten, such efficiencies will determine where digital infrastructure, and by extension, economic advantage, ultimately concentrates.

Case study

Microsoft: Sustainability by design

Microsoft has created the "world's most powerful datacenter" in Wisconsin. At the heart of the design is a state-of-the-art closed-loop liquid cooling system, over 90 percent of the facility is cooled using water that is filled during construction and recirculated continuously. The same water is used repeatedly to keep the servers cool, instead of constantly bringing in new water. This approach dramatically reduces water consumption, using it only as much annually as a typical restaurant. On the hottest days, water cooling is only used as a backup for the few servers that normally rely on outside air, keeping the environmental footprint low.

In addition, Microsoft are pre-paying for energy and electrical infrastructure, every kilowatt-hour consumed from fossil fuels will be matched with carbon-free energy returned to the grid.[13]

[13] Made in Wisconsin: The world's most powerful AI datacenter, Microsoft, September 2025

Case study

Google DeepMind AI for data center energy efficiency

Google operates one of the world's largest data center networks, consuming vast amounts of electricity to power and cool its servers. Traditional rule-based cooling systems could not keep pace with fluctuating workloads or changing environmental conditions. The challenge was to reduce energy use without compromising performance or reliability, an imperative as data centers became a major contributor to Google's overall carbon footprint.

Google partnered with its AI subsidiary DeepMind to design a reinforcement-learning system capable of autonomously optimizing data-center cooling. The AI continuously analyzed data from thousands of sensors, temperature, power, pump speeds, and cooling load, and learned to predict how different control actions affected energy consumption. It then made real-time adjustments to the cooling infrastructure, working within strict safety and performance parameters.

Within months of deployment, the AI system cut energy used for cooling by up to 40 percent and overall data-center energy consumption by 15 percent. The model continued to learn and improve, eventually operating semi-autonomously under human oversight. The project demonstrated that AI could deliver measurable, scalable gains in energy efficiency, transforming data centers from high-intensity energy consumers into testbeds for intelligent sustainability innovation across Google's global operations.[14]

[14] AI-Driven Data Center Cooling: Google vs ProphetStor, ProphetStor, 2025

KPMG client story

Wind farm digital twin, optimizing performance

By harnessing the power of AI, companies can unlock the full potential of their existing investments in green technology, as illustrated by the work of KPMG with a leading renewable energy company to enhance wind farm performance through a sophisticated digital twin.

The challenge

A leading renewable energy company managing a large portfolio of wind assets, wanted to understand whether it was fully exploiting the potential of its turbines. The company faced a common but critical question: how can the performance of each turbine be optimized to maximize output while preventing costly outages?

Despite a wealth of operational data, the company lacked the insight needed to identify inefficiencies, anticipate failures, and plan for long-term performance improvements.

KPMG response

KPMG developed a digital twin, a mathematical model mirroring the behavior of the company's wind turbines in real time. By integrating historical operational data with external environmental and market data, the digital twin became a powerful analytical tool for optimizing turbine performance.

The AI-enabled system continuously analyzed variables including wind speed, direction, and air density to identify the ideal configuration for each turbine. This predictive insight allowed operators to anticipate degradation, schedule maintenance proactively, and fine-tune control parameters to achieve maximum efficiency.

The outcome

Through the digital twin model, the company gained a deeper understanding of how its assets perform under different conditions, enabling smarter operational decisions and improved energy output. The project demonstrated how AI-driven modeling can accelerate the clean energy transition, extracting more renewable power from existing infrastructure while reducing waste, downtime, and emissions.

Stern's insight: AI delivers far more than it costs

Lord Nicholas Stern's team at the London School of Economics published findings that finally quantify what optimists have been claiming: AI could cut 3.2 to 5.4 billion tons of CO_2 annually by 2035, showing that AI's climate contributions far outweigh its carbon costs.[15] The peer-reviewed study examined five sectors, power, transport, food, buildings, and industrial processes, using a bottom-up analysis of actual use cases.

The statistics and ratios are compelling: for every gross ton of CO_2 emissions AI creates, it could help remove or avoid three to eight tons, a return on investment that would make any executive take notice. Data centers produce about 180 million tons of emissions today. Even the low end of Stern's projections is eighteen times that amount. Which means AI's climate handprint could dwarf its footprint.

5.4 Gt
high estimate of avoided emissions by 2035

3.2 Gt
low estimate of avoided emissions by 2035

[15] Green and intelligent: the role of AI in the climate transition, The London School of Economics and Political Science, June 2025

02

AI powering clean energy transition

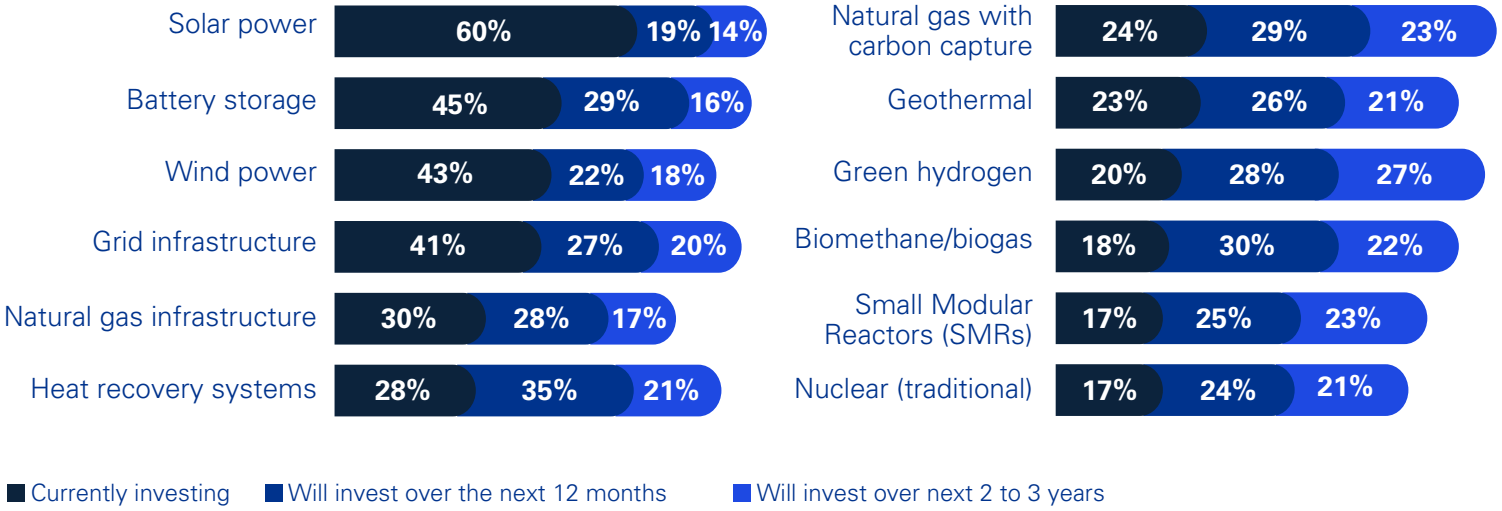
The surge in AI demand has created a once-in-a-generation opportunity to fast-track renewables, modernize grids, and unlock unprecedented system efficiency. This chapter reframes AI's energy impact as a force for energy transition. For leaders, it reveals how aligning AI growth with clean power investment can turn sustainability from constraint into competitive edge.

For decades, the clean-energy transition has been driven by policy targets, public pressure, and environmental conviction. Progress was steady, but incrementally, too slow to match the scale of the climate challenge.

AI's extraordinary rise has created a demand shock. Meeting that demand from fossil fuels would undermine climate goals. Meeting it with renewables could fast-forward them by decades but this has proved an elusive objective notwithstanding all the progress made to date.

Consequently, the very technology once feared as an energy burden is becoming the most powerful demand signal for clean power investment in modern history. Across governments, industries, and hyperscalers, long-standing barriers are falling. Technology is advancing. Grids are being rebuilt and as we look to the future new forms of energy generation will proliferate such as natural gas, geothermal and green hydrogen.

Adoption of clean energy technologies — today vs. future



KPMG insight

AI accelerating renewables adoption

In my role, I see firsthand how AI is transforming the landscape for clean power. This report highlights AI's role in accelerating renewables adoption, and this is precisely where AI becomes a game-changer for decarbonization. AI's capacity to optimize grid integration, predict renewable output, and manage demand dynamically is making clean energy sources more reliable and economically attractive than ever before. Even more importantly, this technological advancement is creating an unprecedented market pull for renewables, driving investment and innovation that will be crucial for achieving net-zero goals across all sectors, far beyond what policy alone could achieve.

Mike Hayes
Global Head of Renewable Energy,
KPMG International and Partner,
Climate Change and Decarbonization Leader
KPMG in Ireland

There are a number of distinct factors at play which lead us to the conclusion that AI will accelerate the energy transition as follows:

Technology acceleration: Innovation at warp speed

AI's energy appetite is reshaping the innovation timeline for clean technology solutions. What once took decades to reach commercialization is now being pulled into the market in years, propelled not by subsidies but by private investment backed by guaranteed demand.

Small Modular Reactors (SMRs) are a case in point. Microsoft and other hyperscalers are investing directly in nuclear micro-generation, integrating energy capability into their operating models.[16] Microsoft's partnerships in the SMR space signal a new role for tech firms, not just as consumers of power, but as developers of it.

Fusion development is also moving faster. AI-assisted plasma modeling and predictive analytics are compressing the time between prototype and pilot. Private fusion firms now see AI data centers as their first commercial customers, reversing decades of reliance on public funding.

The same pattern extends across geothermal, biomethane, and advanced storage. Smarter algorithms are improving drilling precision, optimizing battery performance, and balancing distribution networks. Even in cooling, a critical and often overlooked area, AI is driving breakthroughs, from ambient-air systems used to produce clean water to closed-loop heat recovery, reducing both water use and waste heat.

It is a self-reinforcing virtuous loop: AI creates predictable, high-value energy demand. That demand draws private capital. Capital accelerates innovation. Innovation expands clean capacity and that in turn enables more AI.

Grid transformation

For years, the grid has been one of the key limiting factors in the energy transition, outdated, reactive, and slow to adapt. AI is transforming it into something more dynamic: a living, learning system capable of balancing supply, predicting demand, and preventing outages in real time.

Examples are multiplying:

- Norway's Elvia, in partnership with Siemens, uses an AI-powered digital twin of its low-voltage network to optimize capacity and reduce outages.[17]
- Schneider Electric in France applies AI to balance renewables dynamically, allowing far greater usage than traditional systems can manage.[18]
- In the United States, PJM Interconnection, the country's largest power market cut clean energy project approval times from decades to just a few years by using AI-driven connection modeling. The technology simulates grid impacts and optimizes routing in real time, enabling faster integration of renewables.[19]

Across continents, distributed coordination systems are orchestrating local solar arrays, battery networks, and electric vehicle fleets to stabilize demand. High-precision forecasting models now anticipate wind and solar variability with remarkable accuracy, reducing waste and building confidence in renewables as dependable base-load sources.

[16] Why Tech Giants Are Investing Billions in Nuclear Power Over Renewables, Nuclear Business Platform, May 2023
[17] Siemens and Elvia partner to increase grid capacity in parts of Norway by 2030 with SaaS solution, Siemens, November 2023
[18] How AI can be an ally in the energy transition, Schneider Electric, June 2025
[19] Google deploys AI to speed up connections at PJM, largest US power grid, Reuters, April 2025

The result is a grid that not only supports AI's energy demand but becomes smarter as a result and which will help to enable the clean energy transition.

The hyperscaler revolution

Nowhere is this convergence between AI and the energy transition moving faster than among hyperscalers. Within three years, more than 60 percent expect to generate their own power, transitioning from passive energy consumers to active energy producers. All things being equal, the hyperscalers would prefer to power data centers from clean energy sources — subject to availability.

AI accelerates the consumer-to-producer energy model:

63%

will be generating their own energy on site within three years, with 20% already doing this today.

Primary drivers for energy consumption by segment and region

Energy consumers

ASPAC

Data center capacity increases	**42%**
New production facilities	**39%**

EMA

AI and machine learning workloads	**43%**
Increased computing demand	**40%**

Americas

Data center capacity increases	**52%**
AI and machine learning workloads	**52%**

Energy producers

ASPAC

Data center capacity increases	**44%**
New product/ service offerings	**41%**

EMA

AI and machine learning workloads	**37%**
Regulatory/compliance requirements	**36%**

Americas

Digital transformation initiatives	**43%**
New production facilities	**40%**

This is not energy procurement; it is market creation. AI giants are investing directly in wind farms, solar arrays, and modular nuclear facilities to power their operations. Microsoft's partnership with Nscale and Aker in Northern Norway illustrates the model leveraging hydro power, cool climate, and low grid congestion to secure clean energy independence.[20]

In Denmark, Microsoft and Ørsted are demonstrating innovative approaches to carbon emission management, whereby Microsoft will facilitate the removal of one million tonnes of carbon from the straw-fired unit at Denmark's Avedøre Power Station. This pioneering initiative leverages biogenic carbon capture and storage, transforming agricultural by-products into negative emissions that actively extract CO_2 from the atmosphere.[21]

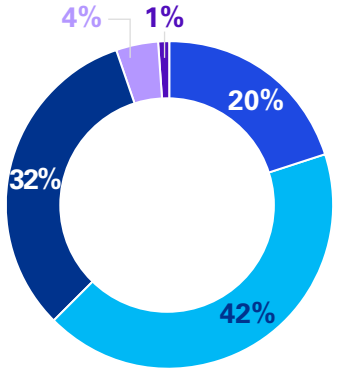
These companies are no longer purely digital enterprises. They are digital-energy hybrids, combining computation and generation into one integrated model. Energy self-sufficiency delivers resilience, cost control, and reputational advantage, benefits their grid-dependent competitors cannot easily replicate. Data from our survey supports this view.

Many hyperscalers intentionally design for surplus generation, feeding excess electricity back to national grids. In doing so, they are becoming distributed utilities, contributors to national resilience as well as engines of digital growth.

A new kind of enterprise is emerging AI-native, energy-self-sufficient, and grid-interactive. These organizations will not just shape the future of technology; they will help define the architecture of the 21st-century energy system.

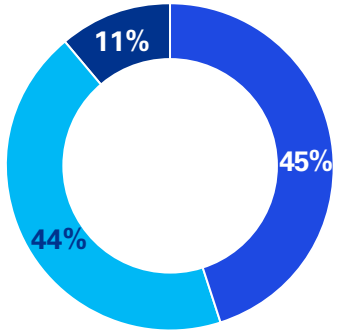
Energy self-generation becomes a mainstream corporate strategy as data centers and hyperscalers target resilience and grid independence

Exploration of energy generation as a strategy



- We already generate our own energy
- We expect to generate our own energy within the next three years
- We see the possibility of energy generation as a long-term strategy
- We might consider this, but it is not a strategic priority
- We are not considering this at all

How onsite generation will be deployed



- We will meet our energy needs primarily through onsite generation
- We will use onsite energy generation to 'top up' what we purchase from the grid
- We will generate excess energy onsite which we can sell back to the grid

[20] The port in Norway emerging as an AI hub, Microsoft, September 2025
[21] Ørsted enters into new major agreement on carbon removal with Microsoft, Orsted, May 2024

Geography redrawn

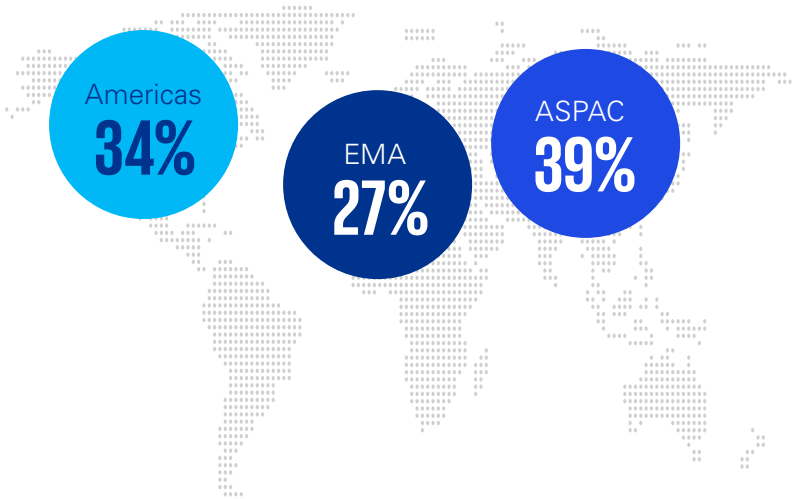
The geography of AI and energy is shifting. Industrial power is no longer defined solely by labor or capital, but by whoever can deliver abundant clean electricity. Emerging economies are increasingly well positioned to lead this next phase, not because they are cheaper, but because they can build from scratch.

"AI, IoT, and sector-specific workloads — from smart manufacturing and energy grids to agriculture and healthcare research — are driving growing demand for high-performance compute. Each new model or application creates spikes in data and processing that conventional infrastructure cannot handle. That's why campuses must be designed so compute, power, and cooling scale together, enabling enterprises, startups, and government agencies to expand seamlessly while keeping operations efficient, resilient, and sustainable."

Sunil Gupta
CEO and Co-Founder,
Yotta Data Services

Our data shows that executives in ASPAC report 39 percent alignment between growth and sustainability goals, compared to 27 percent in EMA. Over the past decade, non-OECD countries have deployed renewable energy twice as fast as their OECD peers. China alone accounted for more than half of global new capacity in 2024.

Executive compatibility between growth and sustainability



Infrastructure innovation is advancing rapidly in high-growth markets. As one KPMG energy leader put it, "When China optimizes its grid for AI, it is optimizing infrastructure built this decade. When Germany does it, it's modernizing one built a century ago."

As a result, investment capital is following energy availability. Data-intensive industries are migrating toward regions with abundant renewables and modern infrastructure, shifting the center of digital gravity toward markets once considered peripheral. To put all this in a different way, those countries that can offer renewable energy and other clean energy sources in abundance will reap the advantages of attracting greater levels of AI investment as well as accelerating their own energy transition.

Case study

Yotta Data Services — Sustainability by design

In India's rapidly expanding digital infrastructure landscape, Yotta Data Services, which specializes in hyperscale data centers, cloud services and managed IT solutions, stands out for treating sustainability as part of the engineering blueprint.

The company is integrating solar and wind power with pumped storage plants to smooth out supply fluctuations, a crucial step in ensuring uninterrupted clean power for its hyperscale data centers.

CEO and co-founder Sunil Gupta explains, "We are evaluating a blend of large and small hydro projects, along with other renewable sources, to further optimise our portfolio. This includes recovering and reusing waste heat, deploying alternative cooling technologies, and expanding our in-house captive solar capacity to reduce grid dependence."

Yotta's facilities feature a suite of innovations that make sustainability visible in daily operations. Air-cooled chillers with adiabatic kits improve heat exchange efficiency, while closed-loop liquid cooling and rainwater harvesting reduce water demand. Every new data center is built to meet high environmental standards, using intelligent airflow management, LED lighting, and water-efficient systems.

AI-driven energy management and optimised Heating, Ventilation and Air Conditioning systems (HVAC systems) continuously tune performance, ensuring that sustainability and efficiency reinforce each other.

Yotta's model shows how a data infrastructure provider can grow rapidly in the right geography while shrinking its environmental footprint. [22]

[22] In conversation with Sunil Gupta, the 'Data Centre Man of India', Yotta, August 2019

Conclusion: Clean energy is becoming AI's natural partner

There are three interlocking forces that explain why renewables are fast becoming the default power source for AI infrastructure:

- **Cost certainty:** Renewables can provide long-term cost certainty and therefore resilience.
- **Corporate commitments:** Net-zero pledges are now hardwired into hyperscalers' business models and brand equity. Clean energy procurement underpins both.
- **Systemic reinforcement:** AI itself accelerates renewable deployment, grid modernization, and technology innovation, creating a self-sustaining cycle of clean growth.

It is a paradox with profound implications: an energy-intensive technology that accelerates the very transition needed to make its own growth sustainable.

However, achieving the shift to clean energy sources is not without its challenges as we discuss in the next chapter.

03

Barriers to acceleration: Closing the AI–energy transition execution gap

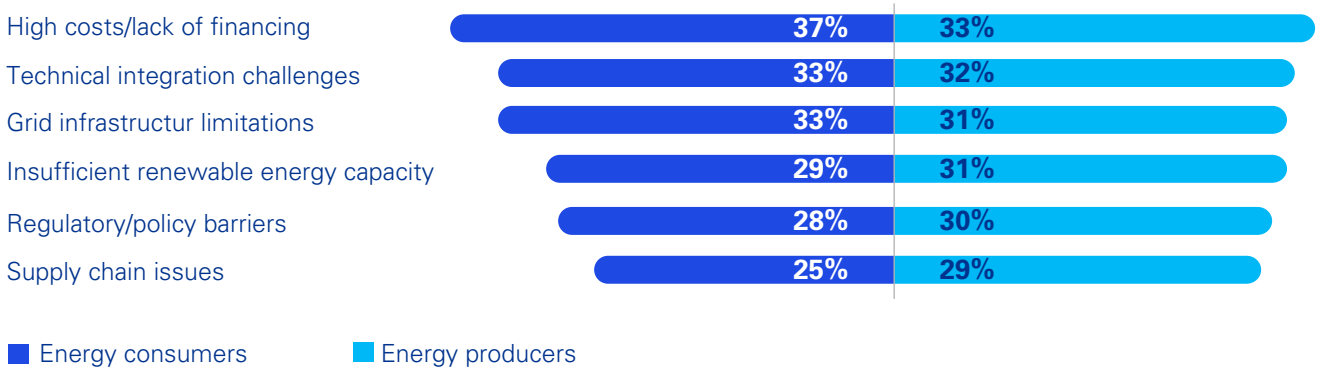
While most leaders recognize AI's potential to accelerate the energy transition, few have converted that belief into decisive action. We explore the structural, cultural, and policy barriers slowing progress, from misaligned incentives to short-term economics. For decision-makers, it offers a candid assessment of what is holding the market back and draws on real world examples of how leading organizations are closing the execution gap.

"The UK has a once in generation opportunity to seize the benefits from the transition in clean power and AI. I am convinced that we only achieve this if energy, tech and government join up. It is key this is supported by policy that looks at the end-to-end requirements of getting data centers built and operating within a clean energy system."

Nikki Flanders
Managing Director,
SSE Energy Customer Solutions

AI's potential to accelerate the clean energy transition should no longer be debated. What remains uncertain is whether the world can move fast enough. Confidence is high, but delivery is slow.

Biggest barriers to increasing supply of energy from clean or renewable sources



KPMG insight

Overcoming barriers with tech and strategic vision

The barriers identified in this chapter, from infrastructure constraints to policy stalemates and financing challenges, are significant, but not insurmountable. In my work with technology and fintech companies, I've observed that these obstacles often present opportunities for innovative solutions. We need to apply the same agility and strategic thinking that drives the tech sector to the energy transition. This means leveraging digital solutions to de-risk investments, streamlining regulatory engagement through data-driven insights, and fostering cross-sector collaborations that can unlock new funding models. The key is to view these barriers not as roadblocks, but as design challenges that can be overcome with bold, tech-enabled strategies."

Anna Scally
Head of Technology, Media and Telecoms,
KPMG EMA; Partner,
KPMG in Ireland

Our research shows that more than 90 percent of energy and natural resources leaders are increasing renewable investment, yet barely half believe they can meet their 2030 emissions goals.

Ireland illustrates the strain. Data centers now consume more than 20 percent of the country's total electricity. To maintain supply, temporary fossil backups have been activated, a stopgap that undercuts net-zero progress. Even under the most optimistic scenarios, fossil fuels could still supply 40 percent of data center energy by 2030.[23]

However, delays are expensive. Research by Resources for the Future (RFF) estimates that in the US and Canada alone, delaying transmission and new generation adds $22–$28 billion a year to customer energy bills, roughly $2 billion for every month of delay, and pushes electricity prices up 3–4 percent.[24]

The 24-month imperative: Why timing defines the winners

Most executives (62 percent) in our research noted they expect major structural change within three years and are already accelerating planning cycles toward 2027. Our analysis supports this and suggests that by 2027, the AI–energy market will reach a pivotal point, where rising demand, new supply models, and evolving infrastructure reshape global energy production and usage.

After 2027, scarcity will define the market: constrained grid capacity, congested permitting systems, and escalating competition for renewable assets will drive costs sharply upward. Late entrants will face premium pricing, limited access to optimal sites, and diminished negotiating leverage.

Multiple hard indicators support this timeframe. An estimated 62 percent of hyperscalers will be generating some of their own power, with nearly half relying primarily on on-site sources. AI-related energy use in data centers is expected to increase from 8 percent to 36 percent, while the proportion of companies sourcing three-quarters or more of their power from renewables will grow from 8 percent today to around 30 percent. At the same time, more than 90 percent of energy producers expect double-digit growth in output, highlighting the scale of the shift ahead.

The 24 months between now and 2027 represent a realistic timeframe for companies to prepare. It allows for the negotiation of long-term power agreements, the establishment of renewable partnerships, and the development of infrastructure that typically takes one to two years to deliver.

Beyond 2027, conditions are likely to become significantly more constrained. Competition for renewable capacity, grid connection access, and strategic sites is already intensifying, suggesting that those who have secured their positions early will enjoy greater flexibility and cost stability.

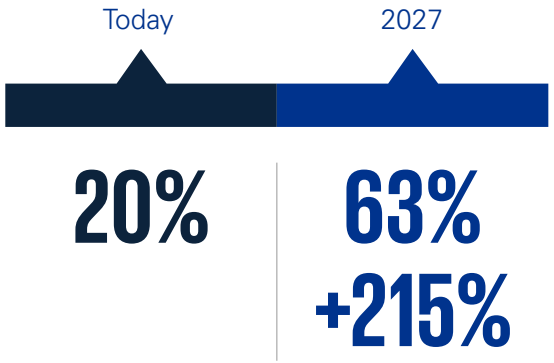
In short, the decisions made between now and 2027 may well define competitive advantage for decades to come.

[23] Data Centers in Ireland Overtake All Urban Electricity Use Combined, EcoWatch, July 2024
[24] Power Delayed: Economic Effects of Electricity Transmission and Generation Development Delays, Resources for the Future, May 2025

How KPMG sees the AI energy future

Energy self-generation

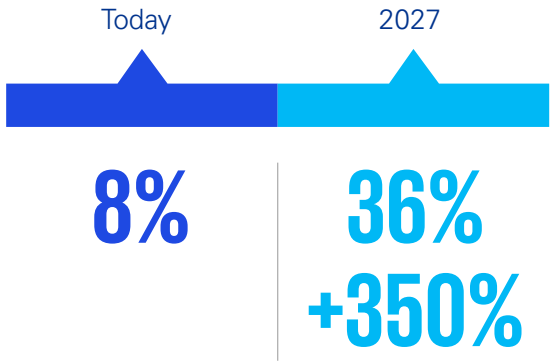
Hyperscalers, data centers, and technology companies



Two-thirds of AI and tech operators become energy independent

AI as majority energy consumer

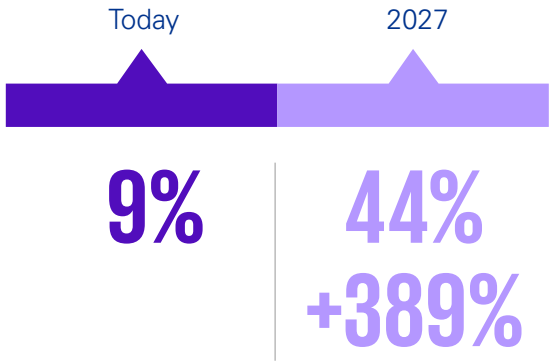
Data centers and hyperscale operators



AI workloads dominate data center energy portfolios

Majority renewable power (50%+)

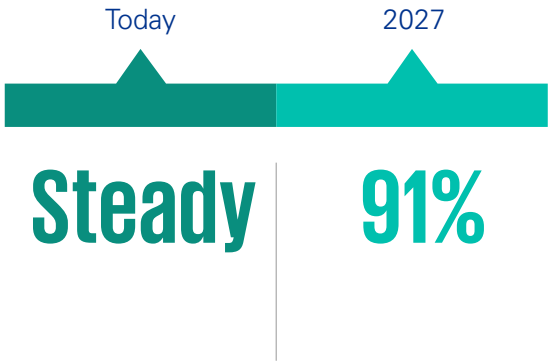
Hyperscalers, data centers, and technology companies



Clean energy becomes operational norm for high-compute sectors

Expecting 10%+ demand growth

Utilities, power generators, and renewable developers



Energy producers face unprecedented infrastructure strain

The acceleration curve

AI's rising energy appetite has forced industries and governments to confront the pace problem at the heart of the energy transition.

Electricity demand from data centers is set to more than double by 2030,[25] with AI workloads compressing decades of digital growth into just a few years.

The paradox is clear: AI may drive the clean energy revolution required to power its own expansion, but only if the world can build fast enough.

The challenge isn't the absolute size of AI's energy footprint, around 1.5 percent of global electricity use, but the speed of its growth. When demand doubles in three years instead of thirty, every weakness in policy, permitting, and infrastructure is exposed. However, each bottleneck is both a risk and an opportunity.

Attitudes towards balancing growth and speed versus clean energy requirements

45%
Strong preference for clean energy, but will use alternatives if necessary to meet commercial goals

36%
Balanced approach — depends on specific circumstances

13%
Clean energy is non-negotiable, even if it delays projects

7%
Speed to market typically takes priority

This section explores some of the barriers to meeting this exponential demand from clean energy sources.

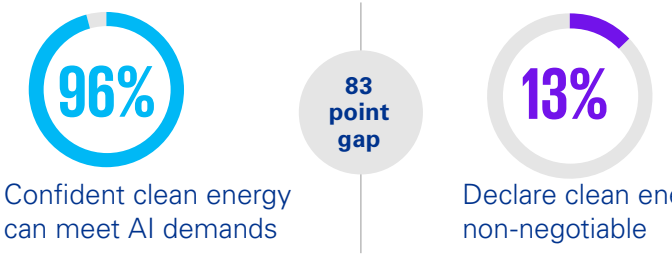
Barrier 1:

The commitment gap

Confidence in clean energy's ability to power AI is almost universal, conviction is not.

Ninety-six percent of executives believe renewable energy can meet future AI demand. Yet only 13 percent are willing to make clean power use non-negotiable if it slows deployment or increases cost. In other words, lack of access to clean power will not deter data center expansion globally. Electricity generated from coal, oil and natural gas will continue to be utilized to drive the AI revolution unless the barriers to scaling clean power solutions can be removed.

Most executives believe in clean AI but won't commit to it



Confident clean energy can meet AI demands

Declare clean energy non-negotiable

NVIDIA's long-term renewable partnerships,[26] Microsoft's fully renewable operations in Norway,[27] and Google's global solar and wind investments[28] show what decisive action looks like. These organizations are not waiting for perfect policy conditions; they are building certainty into their own supply chains and turning sustainability into resilience.

[25] AI is set to drive surging electricity demand from data centres while offering the potential to transform how the energy sector works, IEA, April 2025
[26] Nvidia Targets AI Data Centers And All-Renewable Electricity, Investor's Business Daily, October 2025
[27] Microsoft Signs $6 Billion Deal for 100% Renewable Energy-Powered AI Computing Capacity, ESG today, September 2025
[28] Google's watershed: Responsible data centre water use, DataCentre Magazine, December 2023

Barrier 2:

The timeline challenge

AI scales in months. Renewable infrastructure takes years.

Thirty one percent of companies cite "insufficient renewable energy capacity" as a major barrier. Organizations expect to quadruple their share of renewable electricity from eight percent today to thirty percent by 2027.

Yet permitting, grid connections, and construction cycles still take three to five years. Unless this mismatch is closed, clean energy could meet only half of new AI-driven demand by 2030.

There are some good examples including one where Google and the regional grid operator PJM have introduced new approval processes that cut grid connection timelines from decades to just a few years.[29]

Acceleration is possible, but it requires coordination between technology, infrastructure, and policy that has rarely existed before.

Barrier 3:

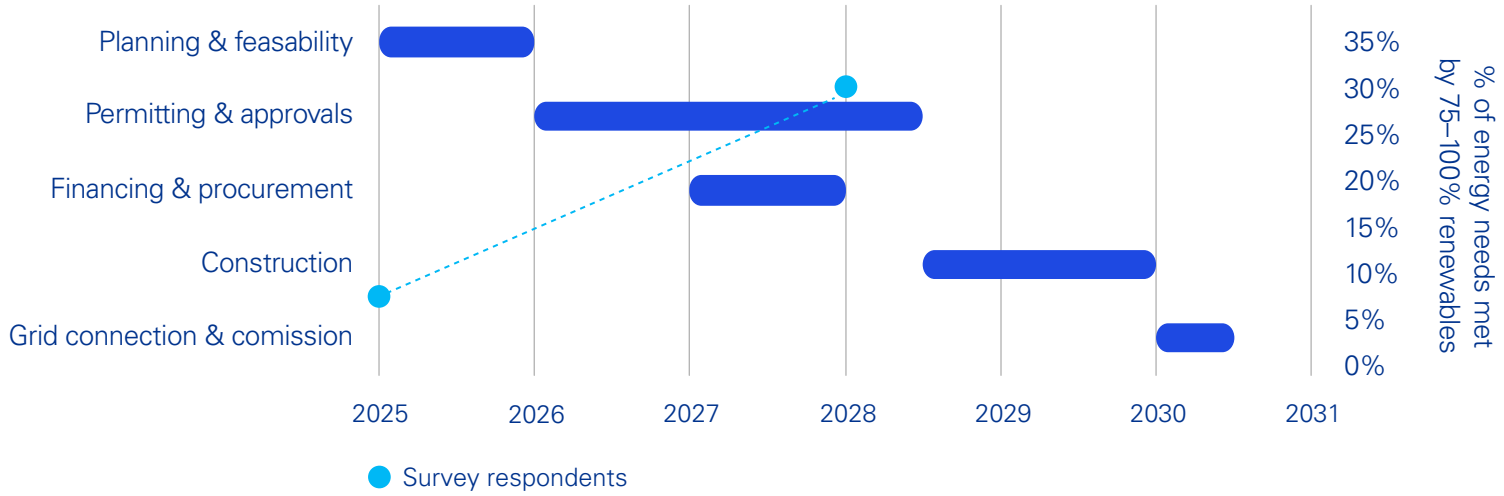
The infrastructure constraint

Behind every confident renewable forecast lies an uncomfortable truth: the grid cannot yet cope. This is a reality in every geography.

One-third of executives cite infrastructure limitations as a top risk to AI's clean-energy ambitions. Outdated transmission systems, underinvestment in capacity, and slow permitting combine to make grid connection the new bottleneck.

Some are refusing to wait. Equinix[30] and Digital Realty[31] are building on-site microgrids and battery storage to stabilize supply. In Singapore, Keppel DC REIT is piloting smart-grid integration to draw cleaner power dynamically from diverse sources.[32] These operators are turning grid bottlenecks into innovation, proving that infrastructure constraint is a solvable engineering problem, not a reason for delay.

Renewable projects take 3-5 years from planning to operation — yet executives expect quadrupling renewable usage in 3 years



[29] Google brings AI to grid teams slashing US connection times, Reuters, May 2025
[30] Equinix Collaborates with Leading Alternative Energy Providers to Power AI-Ready Data Center Growth, PR Newswire, August 2025
[31] Digital Realty: How Data Centres Harness Renewable Energy, Sustainability Magazine, July 2025
[32] Singapore commences first renewable energy electricity import, The Business Times, June 2022

Barrier 4:

The policy stalemate

AI is racing ahead; public policy is struggling to keep up.

Three-quarters of executives cite delays as a barrier. Yet only one in five companies actively engage with policymakers to shape the regulatory environment. This passivity comes at a cost. Policy inertia creates uncertainty, delaying investment decisions and reinforcing the very bottlenecks industry leaders complain about.

Early movers are proving there is another way. Google and Ørsted co-designed market structures that speed offshore-wind integration.[33] In Europe, Iberdrola and Siemens Gamesa are shaping grid-access reforms to align energy supply with industrial demand.[34] The message is clear: those who engage early influence the rules and move first.

Barrier 5:

The financing and cost challenge

The clean-energy economics still deter too many.

Around a third of energy producers (37 percent) and consumers (33 percent) cite "high costs and lack of financing" as a top obstacle.

Projects stall not because technology is lacking, but because funding models have not caught up. Long paybacks and capital intensity make many renewable and storage projects look unattractive next to short-term AI returns.

Yet, the innovators have rewritten the traditional financial models for renewable energy adoption. A prime example is Meta, which leverages virtual power-purchase agreements (VPPAs) to fund the development of large-scale solar farms across states like Texas and Utah. Through these VPPAs, Meta effectively locks in fixed prices for electricity for an extended period, often two decades. This innovative approach allows them to support the creation of new renewable energy capacity without directly owning or operating the physical assets, thereby mitigating financial risks and making significant strides towards their clean energy goals.[35] Apple issued green bonds exceeding US$5 billion to finance its own clean-energy assets, cutting reliance on utilities altogether.[36] Google's partnership with Ørsted adds a financing dimension, co-developing offshore wind so that energy supply grows in tandem with compute demand.[37]

A defining moment

AI has exposed the fragility of the global energy system but also revealed its possibilities.

Each of these barriers, commitment, time, infrastructure, policy, and finance, represents more than a constraint. They are drivers of innovation, shaping where capital flows and which organizations lead.

The next 24 months will determine who closes the AI–energy execution gap and who falls behind it. Those that move first will not only accelerate the energy transition, but they will also define it.

[33] Ørsted signs offshore wind CPPA with Google, Key Facts Energy, November 2021
[34] Iberdrola nominates Siemens Gamesa for 3.1GW offshore wind cluster, Wind Power Monthly, February 2021
[35] Meta's Deal for a 600MW Solar Farm to Power Data Centres, AI Magazine, August 2025
[36] Apple's $4.7B Seed Money Plants 43 New Green Projects, CRN, March 2022
[37] Ørsted and Google sign first PPA in US, Windfair, April 2023

04

Turning barriers into advantage

Turning insight into action is the defining challenge. This last chapter outlines an agenda for aligning AI adoption, clean energy infrastructure, and sustainability strategy into a single acceleration pathway. It focuses on what leaders can do now to achieve climate commitments faster and build intelligent, resilient enterprises.

KPMG insight

The 24-month imperative for project delivery

Chapter 4 emphasizes the critical 24-month window for action, and from an infrastructure and capital projects perspective, this timeframe demands a laser focus on execution. The ambitious goals outlined for hyperscalers, utilities, and developers require robust project management, streamlined processes, and a clear understanding of the interdependencies across the value chain. Success in this period will hinge on our ability to accelerate project delivery, from initial planning and permitting to construction and grid connection. This means prioritizing projects with tangible outcomes, leveraging predictive analytics to optimize timelines, and ensuring that every capital investment translates into measurable progress on the ground.

Reid Tucker
Principal, Infrastructure, Capital Projects and Climate Advisory
KPMG US

The window for advantage is short: the next 24 months will likely determine who captures the upside of AI-climate integration and who remains constrained by legacy approaches. If AI is to be an enabler of climate transition it depends on decisive, coordinated action across all participants of the value chain.

The following actions outline what five groups, Hyperscalers, Utilities, Developers, Investors, and Governments, can do to accelerate clean power, avoid gridlock, and keep AI growth on a sustainable trajectory.

1. Hyperscalers: Lead with pragmatism

Hyperscalers drive the demand signal, if they insist on clean energy and invest ahead of need, it can accelerate the entire ecosystem. They also have tech savvy to pioneer solutions (AI for efficiency, advanced storage) that others can adopt.

Next 6 months

- Lock in renewable capacity. Secure interim power purchase agreements where possible for existing clean energy to cover near-term AI demand.
- Tighten efficiency everywhere. Deploy AI-led optimization (cooling, workload management, demand shifting) to limit load growth. Target 10–15 percent energy reduction in existing facilities.

Within 24 months

- Co-invest in new generation. Develop or part-own renewable assets near data hubs to secure supply and reduce grid pressure. By 2026, aim for half of incremental load backed by self-sourced clean energy.
- Integrate storage and flexibility. Add batteries or microgrids at major sites to smooth peaks and support local grids.

2. Power and utilities: Build capacity and confidence

Utilities are the linchpin; they must ensure that clean supply can reach demand. Right now, there is a "confidence-constraint mismatch": 96 percent of executives (including utility leaders) are confident clean energy can meet AI's needs, yet just as many highlights grid capacity as a top barrier.

Next 6 months

- Audit and act. Map where AI and electrification loads will hit hardest; prioritize critical substations and grid connections. Create "fast-track" teams to cut queue and study times by a third.
- Squeeze more from the existing grid. Deploy software fixes, dynamic line ratings, voltage control, AI forecasting, to unlock 5–10 percent extra capacity.
- Collaborate, do not just connect. Form direct working groups with major data center and industrial customers to co-develop generation and storage solutions.

Within 24 months

- Deliver visible upgrades. Accelerate one or two headline infrastructure projects each year, transmission lines, substations, or high-capacity feeders, proving you can build faster.
- Scale up storage and automation. Deploy utility-scale batteries and advanced distribution management systems to enhance reliability and integrate renewables.
- Modernize commercial models. Offer tariffs that reward flexibility and clean consumption, such as premium green supply or demand-response credits.

3. Energy developers: Build faster, smarter

Energy developers are on the supply side of the equation, without them, the corporate clean energy pledges mean nothing. The global data shows big demand for renewable power (companies project a fourfold increase in high-renewables usage by 2027), but also frustration that builds are not happening fast enough (insufficient capacity cited by one-third as a barrier).

Developers should build confidence by building capacity and remove the excuse to stick with fossil due to lack of clean supply.

Next 6 months

- Cut development drag. Use AI and data tools to identify sites with minimal permitting friction. Apply an "acceleration sprint" approach: daily progress tracking, fewer idle stages.
- Prioritize build-ready projects. Focus on the simplest, fastest-to-complete assets, typically solar and storage, to get new capacity online within 24 months.
- Work the grid connection delays. Co-fund studies or shared transformers with utilities to shorten connection times. Early collaboration beats waiting in line.

Within 24 months

- Double build throughput. Use modular construction and parallel teams to deliver twice as much capacity as in 2023. Prefabrication and standardized design can cut build times by up to a quarter.
- Secure multi-project deals. Aggregate PPAs with hyperscalers or corporates to guarantee long-term offtake and unlock cheaper financing.
- Develop strategic partnerships and alliances with the hyperscalers to ensure closer integration between the supply and demand dimensions.

4. Investors: Make capital move at the speed of transition

Investors provide the fuel in the tank for all other groups' engines. If capital is abundant and cheap for green projects, developers can build more, utilities can modernize, and companies can adopt clean tech without fear of hurting shareholder value. Conversely, if capital stays on the sidelines or is only available at prohibitive cost, progress stalls. Our research flagged financing as a top three barrier (around one-third see prohibitive costs/ lack of financing as an obstacle):

Next 6 months

- Signal readiness. Launch dedicated clean energy and grid funds aligned to AI-driven demand growth. Public commitments catalyze pipelines.
- Pilot financing tools. Trial bridge facilities or sustainability-linked credit that directly address capital bottlenecks. Reward borrowers for hitting efficiency or renewable milestones.
- Engage on regulation. Use investor voice to advocate for permitting reform and policy stability, demonstrating that finance stands ready if rules are clear.

Within 24 months

- Scale and multiply. Double or triple capital deployed to clean infrastructure versus 2023. Partner with governments on blended finance or green banks to amplify leverage.
- Match financing to asset life. Structure 20–30-year green bonds or securitized PPA portfolios to give developers long-term certainty.
- Tie performance to capital cost. Mainstream sustainability-linked loans and bonds make progress cheaper, and delay more expensive.

5. Governments: Drive rapid, coordinated progress

Governments can create a more dynamic, efficient, and attractive environment for accelerating the energy transition, ensuring that both policy and infrastructure keep pace with the urgent need for decarbonization.

Next 24 months

- Build robust frameworks and efficient administrative processes. Look to accelerate policies while fast-tracking permitting of renewable energy projects. The permitting process for renewable energy projects is often lengthy, complex, and involves multiple agencies, leading to significant delays and increased costs.
- Focus on grid investment, in particular remove barriers to private investment into national grid projects and utilize public: private partnerships to modernize and expand electricity grids to accommodate increased renewable energy, and the importance of attracting private capital to achieve this.

Collective impact: The 24-month imperative

If these five groups act together, AI's growth can drive, not derail, climate improvement and energy transition.

- **Hyperscalers** create immediate demand signals and demonstrate practical sustainability.
- **Utilities** deliver the capacity backbone.
- **Developers** expand clean generation at pace.
- **Investors** keep the financing flywheel spinning.
- **Governments** remove policy barriers to private investment into grids and introduce policies that fast track permitting.

This 24-month sprint is about momentum, credibility, and coordination. The window is short, but the opportunity, aligning digital acceleration with climate progress, is once in a generation.

Potential risks and challenges

Several factors could impede progress. Leaders should be mindful of these potential pitfalls and consider mitigating actions:

For Hyperscalers:

- Inability to secure renewable capacity. Unexpected delays, regulatory hurdles, or competition.
- Integration challenges with storage and flexibility. Technical complexities, interoperability issues, or higher-than-expected costs.

For Power and Utilities:

- Grid capacity constraints persist: The existing grid might still struggle to accommodate the rapid increase in AI and electrification loads.
- Slow infrastructure upgrades: Accelerating headline infrastructure projects (transmission lines, substations, high-capacity feeders) could be hampered by permitting delays or community opposition.

For Energy Developers:

- Persistent development drag. Permitting friction and bureaucratic processes could continue to slow down project development.
- Interconnection bottlenecks remain. Co-funding studies or shared transformers might not sufficiently shorten connection times.

For Investors:

- Insufficient capital mobilization: Despite dedicated funds and public commitments, capital might not flow at the required speed or scale into clean energy and grid projects.
- Ineffective financing tools: Pilot financing tools (bridge facilities, sustainability-linked credit) might not effectively address capital bottlenecks.

For Governments:

- Slow policy acceleration and permitting: Despite intentions, governments might struggle to fast-track permitting for renewable energy projects.
- Limited grid investment: Barriers to private investment in national grid projects might persist.

Overarching risks:

- Lack of coordinated action: If the five groups (Hyperscalers, Utilities, Developers, Investors, and Governments) do not act together in a coordinated manner, individual efforts may be insufficient to drive the necessary climate improvement and energy transition.
- Economic downturn: A significant economic downturn could reduce investment in clean energy projects and slow down AI adoption, impacting the overall pace of the energy transition.

Conclusion:
From climate burden to climate breakthrough

AI's story in the climate debate has often been told through the wrong lens, as a problem to be contained rather than a capability to be unleashed. Yet our research, and the evidence emerging across every sector, points to a far more powerful truth: AI is not a threat to climate progress; it is likely the greatest accelerator of it.

However, the climate clock is ticking. Companies that fail to embed clean energy and climate considerations into their core strategies now risk being left behind and having to invest heavily to catch up.

The energy demands of AI are real, but they are also forcing long-delayed infrastructure upgrades, spurring innovation in clean generation, and driving unprecedented collaboration between technology providers, utilities, and governments. What looks like consumption on one side of the ledger becomes capability on the other: the ability to forecast demand, optimize grids, design low-carbon materials, decarbonize transport and industry, and accelerate every dimension of the transition.

The organizations leading this transformation share a defining characteristic: they integrate AI and energy strategy, rather than treating them as competing priorities. They view AI's energy footprint not as a cost to minimize, but as an investment in cleaner, smarter, and more resilient systems. The more deeply AI is embedded into the energy transition, the faster costs fall, emissions decline, and innovation compounds.

To realize this potential, certain barriers must still be removed, fragmented regulation, inadequate data access, legacy infrastructure, and short-term planning horizons among them. Our recommendations focus on enabling AI-energy integration through shared data ecosystems, adaptive governance, investment in clean infrastructure, and public-private partnerships that scale solutions beyond pilot stages. But these are enablers, not caveats. The central message remains unchanged: the benefits of AI-driven climate action outweigh the costs.

The challenge ahead is not to slow AI down, but to steer it wisely. If we can align ambition, policy, and innovation at the speed AI is now advancing, the technology that once appeared as a burden could become the most powerful ally humanity has ever had in achieving net zero.

The conclusion is clear: Act now, AI's climate handprint is set to dwarf its footprint. The 24-month framework provides the route map. This is a once-in-a-generation opportunity to turn technology's appetite for energy into the engine of a cleaner, more sustainable future.

How KPMG can help

Around the world, we're helping organizations harness artificial intelligence to accelerate progress toward net zero while managing the risks that come with rapid technological change.

From designing AI-powered carbon tracking systems that quantify and manage emissions in real time, to advising data-intensive businesses on renewable energy procurement and on-site generation, to implementing AI and IoT-driven energy efficiency solutions, KPMG firms bring together deep expertise in technology, energy, and ESG. Our teams also develop governance frameworks that ensure AI initiatives remain aligned with sustainability commitments and facilitate collaboration between technology and energy companies to drive innovation at scale.

KPMG professionals help clients by uniting our technology consulting, sustainability advisory, and energy sector specialists around a single goal, turning AI's tension with climate responsibility into competitive advantage.

Through our Enable, Embed, Evolve framework, we support clients at every stage of the journey:

- **Enable** — Align AI strategies with sustainability goals, assess data, energy, and infrastructure readiness, and ensure innovation scales responsibly.
- **Embed** — Operationalize AI across value chains using clean-power strategies, carbon-intelligent algorithms, and real-time analytics to decarbonize operations.
- **Evolve** — Build long-term resilience through AI governance, transparent reporting, and ecosystem partnerships that optimize performance and sustainability outcomes.

The KPMG Trusted AI Framework aims to ensure every AI initiative is ethical, explainable, secure, and sustainable. By embedding responsible AI principles into design and deployment, we help organizations protect data integrity, manage model risk, and build stakeholder confidence.

Our Major Projects Advisory team supports clients with every aspect of major infrastructure and energy transition programs, from portfolio and project governance to performance improvement and resilience. Our ESG and Sustainability professionals help organizations measure, report, and improve environmental impact, integrating ESG into business strategy, investment decisions, and financial operations to directly and indirectly reduce carbon emissions.

With over 1,500 energy and sustainability professionals across fifty global hubs, KPMG brings both scale and precision. Our global experience allows us to synthesize insights from investors, regulators, policymakers, and industry leaders — enabling clients to make confident decisions, capture new opportunities, and lead with purpose through the transition.

The KPMG leadership in this space is recognized globally. We are proud to be ranked #1 for overall quality of work in TMT consulting, #1 for quality of work in Transformation in ENR, first choice firm for Data & Analytics in ENR and #1 most shortlisted firm for AI advice & implementation in financial services. Results are based on a survey of senior clients and prospects in the TMT, ENR and FS sectors, which was undertaken by analyst firm Source in November — December 2024.

KPMG is also proud to be named a Leader in the 2025 IDC MarketScape for Worldwide AI Services,[38] and recipient of the IDC 2024 Customer Satisfaction Award for Enterprise Intelligence Services, which we believe affirms our position as a trusted advisor for organizations transforming through AI and sustainability.

[38] Worldwide AI Services 2025 Vendor Assessment, IDC MarketScape, July 2025

Research methodology

What we wanted to know: Three questions drove this research: Are executives confident that AI and clean energy can scale together? What infrastructure strategies are companies deploying right now? And where are the execution opportunities between what leaders intend and what they are implementing?

Quantitative survey design: We conducted online research in August and September 2025 with 1,202 executives. An online global research program with over 1,200 executive decision makers across the AI and energy transition value chain was supplemented by interviews with KPMG subject matter experts, external experts and published research from Lord Stern and the IEA.

The survey was structured to encompass twenty markets with research among both energy producers (power generation, utility companies, renewable energy, infrastructure developers) and energy consumers (hyperscalers, data center developers and operators, technology companies).

We focused on senior decision-makers who control infrastructure and energy budgets, including C-suite executives, executive management, and directors. Most came from companies with annual revenues exceeding $1 billion.

Geographic scope: Twenty markets across North America, Latin America, ASPAC and EMA. The following markets were surveyed: Australia, Brazil, China, France, Germany, India, Indonesia, Italy, Japan, Mexico, Netherlands, Saudi Arabia, South Africa, Spain and Switzerland — with significant concentrations in Canada, Ireland, Singapore, UK, and the US.

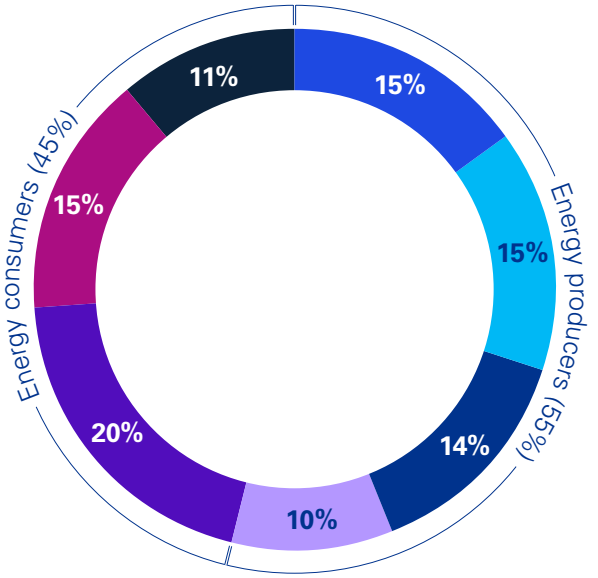
Validation approach: Survey findings were cross-checked against four categories of external sources: academic research, energy market data, regulatory tracking and industry analysis, news and market intelligence. This lets us assess executive perceptions against what's happening in emissions data, energy markets, and peer-reviewed research.

Qualitative interviews: To complement the quantitative survey findings, we conducted a series of in-depth qualitative interviews with senior executives across technology, energy, and policy sectors. These conversations were designed to assess whether stated intentions in the survey, around AI adoption, clean energy integration, and climate action, were being translated into operational reality. Our interviewees represented a cross-section of industries shaping the AI–energy landscape.

What to keep in mind: This survey captures executive perceptions and stated intentions, not verified actions. Where possible, we validated claims against external data. All responses were anonymized, and no individual or company-specific data is reported. Research reflects conditions in August-September 2025. Given the rapid pace of change in AI and energy markets, some findings may shift within months. Some figures may not add up to 100 percent due to rounding.

Research demographics

1,202 Executive respondents across 20 global markets



- Utility companies
- Infrastructure developers
- Renewable energy
- Power generation
- Technology companies
- Hyperscalers
- Data center developers

Executive Seniority	
C-suite/Board Level	**32%**
Executive management	**34%**
Director level	**34%**

Revenue distribution	
$100M–$500M	**15%**
$500m–$1B	**20%**
$1B–$5B	**36%**
$5B–$10B	**19%**
Over$10B	**10%**

Functional area	
Technology	**26%**
Sustainability	**11%**
Innovation/R&D	**8%**
Operations	**8%**
Other (data, general management, finance, strategy, real estate/ facilities management, risk)	**47%**

Glossary of units and terms

Energy units and terms

MW (Megawatt) — One million watts.

Flaring — Controlled burning of natural gas that cannot be processed or sold, typically at oil and gas production sites.

Grid — The interconnected network of power generation, transmission lines, and distribution systems that deliver electricity to end users.

Heat recovery — Systems that capture waste heat from data centers and industrial processes for reuse in heating applications.

Interconnection — The process and infrastructure for connecting new power generation sources to the electrical grid.

Power purchase agreement (PPA) — Long-term contract to purchase electricity directly from an energy generator, often at fixed prices.

Renewable energy — Energy generated from naturally replenishing sources including solar, wind, hydro, and geothermal.

Small Modular Reactor (SMR) — Advanced nuclear reactors with smaller capacity designed for faster deployment and enhanced safety.

Emissions units and terms

CO_2 (Carbon Dioxide) — The primary greenhouse gas driving climate change, measured in tons.

Gt (Gigaton) — One billion metric tons.

Scope 3 emissions — Indirect greenhouse gas emissions from a company's value chain, including suppliers, transportation, and product use.

Net zero — Achieving balance between greenhouse gas emissions produced and emissions removed from the atmosphere, typically targeting 2050 as the completion date.

Technology terms

Artificial Intelligence (AI) — Computer systems capable of performing tasks that typically require human intelligence, including learning, problem-solving, and pattern recognition.

Colocation — Data center facility where multiple organizations rent space for their servers and computing equipment.

Data center — Facility housing computing infrastructure, including servers, storage systems, and networking equipment used to process and store digital information.

Digital twin — Virtual replica of physical infrastructure that uses real-time data to simulate, predict, and optimize performance.

Hyperscaler — Large cloud computing and data center operators operating at massive scale.

Machine learning — Subset of AI that enables systems to learn and improve from experience without being explicitly programed.

Organizations & standards

International Energy Agency (IEA) — Paris-based autonomous organization providing analysis and policy recommendations on global energy markets.

Organization for Economic Co-operation and Development (OECD) — International organization of thirty-eight developed countries focused on economic policy and development.

About the Authors

Mike Hayes
Global Head of Renewable Energy, KPMG International and Partner, Climate Change and Decarbonization Leader, KPMG in Ireland
E: mike.hayes@kpmg.ie

Mike leads the KPMG Global Renewables business, bringing over 24 years of experience, he advises global corporate groups in the renewable energy and infrastructure sectors. In addition to his renewables role, Mike leads KPMG Ireland's climate change and decarbonization sector. He is actively involved in delivering decarbonization services around areas such as climate risk, climate strategy, carbon markets and energy transition for clients in many different sectors. Notably, he provides strategic guidance to private equity firms, asset managers, financial services groups and electric utilities.

Anish De
Global Head of Energy, Natural Resources and Chemicals, KPMG International
E: anishde@kpmg.com

Anish serves as the Global Head for Energy, Natural Resources and Chemicals (ENRC) bringing more than 25 years of experience. Anish is an acclaimed energy sector expert, having pioneered work in corporate strategy, reform and restructuring, policy and regulation, commercial and financial advisory, capital projects, energy markets, smart grids and digital.

Anna Scally
Head of Technology, Media and Telecoms, KPMG EMA; Partner, KPMG in Ireland
E: anna.scally@kpmg.ie

Anna holds leadership roles in both Technology, Media and Telecoms along with International Tax, leveraging over 20 years of experience. She advises large international companies on tax and efficiently structuring and operating their international businesses. She also advises many ambitious early-stage technology and fintech companies on the challenges of growing globally.

Wafa Jafri
Partner, Energy Deal Advisory, KPMG in the UK
E: wafa.jafri@kpmg.co.uk

Wafa is the Global Lead for Energy Transition and UK lead for Energy and Natural Resources Strategy at KPMG, drawing on 15 years of experience. Wafa has worked with major energy companies and a variety of global manufacturing companies advising on creating and executing energy transition plans. She advises global clients on strategy, partnerships and deals in the energy transition space.

Reid Tucker
Principal, Infrastructure, Capital Projects and Climate Advisory, KPMG US
E: reidtucker@kpmg.com

Reid is currently a Principal in the KPMG Major Projects Advisory practice with over 19 years of project management, construction management, project accounting and contract administration. Reid currently provides consulting services across the built environment for owners, government agencies, contractors, and PE firms related to capital programs and critical infrastructure investments.

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Managing Director, SSE Energy Customer Solutions

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Discussed how AI is being deployed across generation and grid operations to optimize efficiency and enable predictive, self-balancing energy systems.

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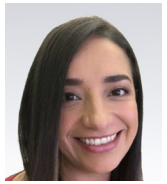
Offered a national development lens, explaining how Ireland is positioning itself as a sustainable AI hub by aligning investment policy, clean energy supply, and digital infrastructure planning.



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Shared insights on the opportunities to turn data centers into flexible grid resources rather than being 100 percent takers of energy.

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