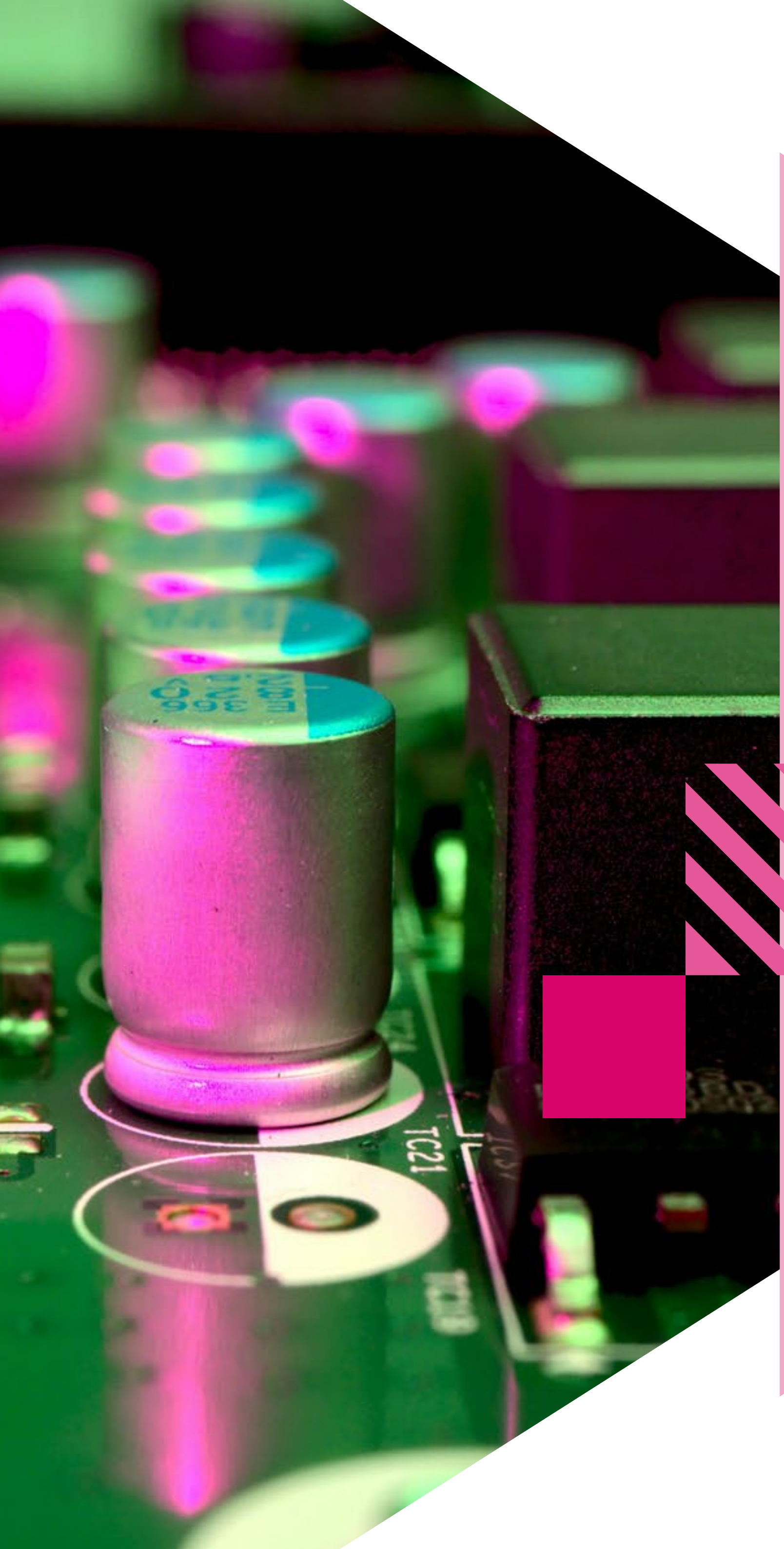

CAF DEVELOPMENT BANK OF LATIN AMERICA AND THE CARIBBEAN

Microsoft

Artificial Intelligence & Energy: An Overview of Emerging Practices

TITLE
Artificial Intelligence & Energy: An Overview of Emerging Practices

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Foreword

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The world is undergoing a profound transformation driven by the convergence of three defining forces: the climate crisis, widening inequality, and rapid technological change. In Latin America and the Caribbean, this dynamic converges with the triple transition—green, digital, and energy —with particular emphasis on fostering human development.

In this context, artificial intelligence (AI) has emerged as one of the most disruptive and promising tools of our time. Its influence is already evident in the energy sector, where it is enabling more accurate demand forecasting, improving the integration of renewable sources, and reducing transmission losses.

Yet these advances come with complex challenges—ranging from the use of AI strategies as enablers of broader industrial and productive policies and the ethical use of AI, to cybersecurity risks and achieving the balance between the need for high-performance computing and clean energy in the region.

For Latin America and the Caribbean, a region rich in renewable resources from solar corridors in the north to vast hydroelectric reserves in the south, AI offers a pathway to a cleaner, more efficient, and more inclusive energy future. This vision is closely linked to the "triple transition"—green, digital, and energy—that the region must navigate simultaneously, with human development at its core. Realizing this potential requires overcoming infrastructure gaps, large scale financing, institutional limitations, and the risk of widening inequality if adoption is uneven.

This is why CAF – Development Bank of Latin America and the Caribbean – and Microsoft have joined forces to sponsor this report. Our shared goal is to combine technical expertise, regional knowledge, and global best practices to help governments, companies, and communities harness AI for energy transformation that aligns with both climate and social priorities.

Through this report, we aim to equip decision-makers with insights, regional examples, and practical recommendations that will guide the responsible use of AI in the energy sector. This publication hopes to serve policymakers, industry leaders, researchers, and practitioners who seek to understand not only the transformative role of AI in energy, but also how to implement it in ways that reflect the region's values and priorities. By combining technological innovation with strong governance and cross-sector collaboration, Latin America and the Caribbean can harness AI to build an energy future that is cleaner, smarter, and more equitable.

CAF's regional AI strategy underpins this vision. Through initiatives such as the CAF–UNESCO Latin America and Caribbean Ministerial Summit on AI, the regional roadmap for ethical AI, and support for high-performance computing governance, CAF is working to ensure that AI adoption—particularly in sectors like energy—serves as a catalyst for sustainable development and social inclusion.

This report is not only a reflection of current opportunities but also a cornerstone of CAF's broader commitment to positioning the region at the forefront of responsible and transformative AI adoption, anchored in a just energy transition that balances environmental stewardship with social inclusion.

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Abstract

Artificial intelligence (AI) is reshaping electricity systems by optimizing production and grid performance while also driving new electricity demand through data centers running generative models. As both an enabler of decarbonization and a source of growing energy use, AI creates opportunities for efficiency and inclusion but also heightens socio-technical risks tied to rising electricity consumption and governance gaps. This policy brief examines these dual dynamics and emerging trends across the energy value chain, with a focus on Latin America and the Caribbean. It concludes with policy recommendations to align AI deployment with climate goals, equity, and sustainable energy transitions.

01 Introduction

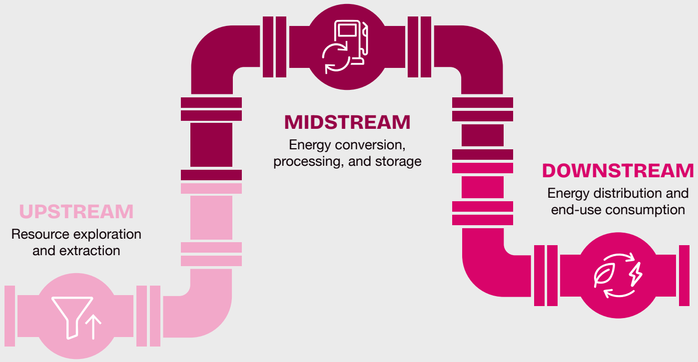
1. Introduction

The global energy sector is undergoing a profound transformation driven by four intersecting challenges: climate change, energy inequality, economy-wide electrification (transport, heating, industry), and the rapidly growing power demands of artificial intelligence (AI). These forces are reshaping not only how energy is produced, distributed, and consumed, but also how technological systems are governed in relation to environmental sustainability and social equity.

AI holds enormous promise for optimizing energy systems, accelerating decarbonization, and supporting inclusive energy access. Yet the growing electricity demands of AI infrastructure—from data centers, generative models, and cloud computing—are placing new pressures on power grids and driving up consumption.

To frame the analysis that follows, this policy brief adopts a comprehensive view of the energy value chain, a conceptual framework widely used in the energy sector to map the interconnected stages of energy systems. According to Luo et al. (2024), the energy value chain encompasses three main segments: upstream, midstream, and downstream.

This framework supports a systematic analysis of how AI intersects with each stage by optimizing production, enhancing grid performance, and introducing new forms of demand.



Source: Authors based on Luo et al. (2024)

This policy brief examines the sociotechnical and governance aspects of this integration, focusing on the implications for emerging economies, particularly those in Latin America and the Caribbean (LAC). It analyzes the dual role of AI as both a tool for energy-system optimization and a driver of new consumption, and highlights emerging paradigms, regional use cases, and policy frameworks. The brief concludes with key considerations for leveraging AI responsibly in the energy sector, along with recommendations to promote transparency, align digital infrastructure with climate goals, and ensure that the benefits of AI in energy systems are distributed equitably.

02 Emerging concepts

2. Emerging concepts

The integration of AI into energy systems is generating a broader set of trends that blend technical innovation with environmental and social considerations. This section outlines key definitions, technical pillars, and sociotechnical dimensions that serve as a conceptual foundation for this policy brief.

Key definitions

- AI for Decarbonization: A strategic application of AI to reduce carbon emissions across the energy value chain. It includes optimizing renewable integration, reducing waste in energy production, distribution, and use, as well as enabling more efficient industrial processes (IEA, Energy and AI analysis, 2024; Microsoft, AI for Sustainability Playbook).

- Energy Justice: A framework that seeks to ensure equitable access to clean energy technologies, emphasizing participation, recognition, and the fair distribution of both benefits and burdens. AI systems must be designed to promote inclusivity and avoid reinforcing existing inequalities (Global Green Skills Report, 2024).

- Nature-Positive AI: An emerging paradigm that aligns AI development and deployment with biodiversity and ecological regeneration goals. This "nature-positive" concept aims to halt and reverse nature loss by 2030. (Lambertini, 2023). UNESCO is developing its first Nature-Positive AI Toolkit for Policymakers, which is expected to be published in December 2025.

- Green Energies: Renewable and low-carbon energy sources (e.g., solar, wind, geothermal) supported by AI to improve forecasting, efficiency, and integration into national grids (IEA, World Energy Outlook, 2024 & 2025).

Technical pillars

AI's operational role in the energy sector is shaped by a range of technologies:

- Smart Grids: Dynamic, data-driven energy distribution systems enhanced by AI for real-time decision-making and adaptive load management (IEA, Energy and AI – Analysis, 2024). AI in smart grids leverages reinforcement learning to balance supply and demand in real time, while graph neural networks capture the complexity of grid topologies to predict cascading failures. To address data sensitivity between utilities, federated learning is increasingly used to train models collaboratively without centralizing data. Together, these methods enable more adaptive, secure, and privacy-preserving energy distribution systems.

- Predictive Maintenance: AI-enabled diagnostics that anticipate equipment failures in energy infrastructure, reducing downtime and maintenance costs (IBM, Future of AI & Energy Efficiency). For predictive maintenance, deep learning models such as convolutional and recurrent neural networks are applied to sensor data to detect anomalies and anticipate failures before they occur. Bayesian approaches add probabilistic reasoning to account for uncertainty in operating conditions, while transfer learning makes it possible to apply insights from one type of asset to another with limited failure data. These techniques collectively reduce downtime and improve reliability across energy infrastructure.

- Digital Twins: Virtual replicas of energy assets or systems that enable simulation, performance optimization, and scenario analysis (Microsoft, AI for Sustainability Playbook). AI methods for digital twins blend physics-informed neural networks with machine learning, combining theoretical models with empirical data to create highly accurate virtual replicas of assets. Generative AI further expands capabilities by simulating a wide range of possible operational scenarios, including rare or extreme conditions, while optimization algorithms help refine system performance in real time. Digital twins thus become continuously evolving “living” systems for energy operations.

- Prosumers and Microgrids: Decentralized models where consumers also generate energy (e.g., via rooftop solar) and contribute to localized, AI-managed grid systems (Oxford TIDE, 2025). AI in prosumer and microgrid systems often relies on multi-agent models, where each household or local generator is represented as an agent that negotiates energy flows. Blockchain technologies paired with AI provide secure, transparent peer-to-peer energy transactions, while advanced forecasting models integrate weather and demand data to optimize local generation and storage. This combination supports more resilient, decentralized, and community-driven energy networks.

Sociotechnical dimensions

The deployment of AI in energy systems raises important governance and ethical issues:

- Ethical Principles: Responsible AI frameworks call for transparency, fairness, and human oversight in energy-related AI systems (UNESCO Recommendation on the Ethics of AI, cited in multiple global policy briefs).

- Algorithmic Accountability: In the energy context, this means ensuring that automated decisions, such as load prioritization, fault detection, or outage response, are explainable, auditable, and do not inadvertently marginalize vulnerable communities (The Maybe, Where Cloud Meets Cement, 2025; Microsoft, AI for Sustainability Playbook). Recent efforts to improve accountability also include the development of standards for reporting the energy consumption and carbon footprint of AI models. For example, Hugging Face and collaborators have created the AI Energy Score leaderboard, which ranks AI models based on their estimated energy usage and greenhouse gas emissions across lifecycle stages. This transparency initiative promotes responsible innovation by helping developers, policymakers, and users better understand the environmental costs of AI deployment (Lacoste et al., 2024).

03
Trends in AI & energy

3. Trends in AI & energy

Understanding the expanding role of AI across the energy value chain—from resource extraction (upstream) and energy transformation and transportation (midstream) to distribution and consumption (downstream)—is critical for guiding sustainable energy transitions. The value-chain approach allows for a comprehensive assessment of sustainability and efficiency across every stage of energy production and use (Rojek et al., 2025). This integrated perspective is essential for identifying opportunities and risks associated with AI implementation, particularly in the context of the LAC region.

AI is a broad, cross-cutting technology that plays a critical role as an enabler of energy system transformation by addressing complexities in power system planning, operation, and optimization, while supporting electrification. Electrification, which allows tasks to shift from burning fossil fuels to using electricity, is key to energy transition, as it improves efficiency and unlocks greater use of green energy sources. AI can accelerate and expand electrification across transport, industry, and real estate.

A review of more than 250,000 publications on AI applications in the power industry between 1982 and 2022 shows significant use across all segments of the energy value chain, with the largest share related to power retail (downstream, 55%), followed by transmission networks (midstream, 14%) and energy generation (upstream, 13%) (Heymann et al., 2024).

Building on these trends, this section provides an overview of emerging paradigms, regional use cases, and key socio-technical considerations. Drawing on recent studies, available estimates, and practical experiences in LAC, it highlights the transformative potential of deploying AI across the energy value chain, as well as the challenges that accompany it.

3.1. AI for energy optimization: Evolving capabilities and limits

AI-driven technologies are revolutionizing energy optimization through predictive analytics, real-time monitoring, and dynamic demand-response systems. These tools enhance operational efficiency, reliability, resilience, and cost-effectiveness (Biswas et al., 2024). They also make possible real-time energy monitoring systems, essential for effectively tracking and controlling energy use, reducing costs, and mitigating environmental impact (Mischos et al., 2023).

In urban contexts, AI is increasingly applied to smart-city energy systems. Rojek et al. (2025) show that advanced deep-learning algorithms can improve urban energy efficiency by analyzing sensor data to forecast demand and balance energy loads, which is critical for sustainable urban development. In Latin America, AI-based forecasting models already inform decisions about grid investments and operations, reducing renewable energy curtailment and improving grid stability, as demonstrated by Chile's smart-grid system (IEA, Energy and AI, 2025).

At the infrastructure level, companies are leveraging AI to boost operational efficiency. For example, Google's DeepMind reduced data center cooling energy use by 40% by applying deep reinforcement learning to optimize system performance. Google's AI system, trained on historical operational data, continuously analyzed environmental and energy conditions to recommend real-time adjustments to cooling settings (Melguizo et al., 2025; Evans & Gao, 2016). AI also supports grid performance improvements, including real-time demand forecasting, fault detection, and grid stabilization, essential for managing decentralized and renewable energy sources (IEA, World Energy Investment, 2025).

Despite these gains, challenges remain, including uneven AI adoption due to inadequate digital infrastructure, poor data quality, and limited regional expertise. These constraints highlight the need for targeted investments in technology and capacity building. From a regulatory perspective, frameworks are shifting toward performance-based incentives that reward grid optimization, enhancing efficiency and reliability and reducing losses, key to the effective and equitable deployment of AI (IEA, World Energy Investment, 2025).

Within this changing landscape, AI is emerging as an enabler of regulatory compliance. Advanced algorithms can embed policy requirements—such as renewable portfolio standards, carbon pricing, and reliability mandates—directly into operational decision-making. For instance, recent studies show that NSGA-III, a multi-objective algorithm designed to balance trade-offs between economic efficiency, grid flexibility, and regulatory standards, can support operators in navigating these often competing goals (Ding et al., 2025). By embedding regulatory constraints into optimization models rather than treating them as post-implementation adjustments, AI aligns efficiency gains with public policy objectives, strengthening accountability and accelerating the energy transition.

BOX 1 – CHILE'S AI-ENHANCED SMART GRID

Chile effectively integrates AI-driven renewable forecasting models, significantly optimizing its renewable energy resources and reducing emissions and providing a model for sustainable grid modernization in the region (IEA, 2024).

The Coordinador Eléctrico Nacional (CEN) partnered with Tapestry, an AI initiative from X (formerly Google X), to transform its long-term transmission expansion planning. By embedding AI into CEN's annual planning process, the tool enables planners to simulate dozens of renewable and demand scenarios in parallel, cutting computation times by 86% and offering far greater flexibility to anticipate uncertainties.

This innovation strengthens Chile's ability to align infrastructure investment with its ambitious decarbonization pathway, providing a concrete example of how AI can simultaneously improve operational performance and regulatory-driven planning for sustainable grid modernization in Latin America (X, 2025).

3.2. Effects of AI on energy consumption: New demand

While AI holds significant potential for optimizing energy systems, its rapid expansion is also generating substantial new electricity demand, raising important questions about the net impact of AI on sustainability. Quantifying how much of that electricity demand is attributable to AI systems remains difficult, as most AI-related energy consumption today occurs in large cloud and hyperscale data centers, where both model training and inference take place (Kaack et al., 2022). Given the rapid growth in computing power required for training, data centers hosting large-scale AI runs pose significant challenges for energy demand and infrastructure planning, as well as for policymakers seeking to accommodate rising consumption while advancing decarbonization goals. As these facilities become a foundational component of the AI ecosystem, ensuring their alignment with the clean-energy transition will be critical to determining whether AI contributes to—or detracts from—global sustainability objectives (Pilz, Mahmood, & Heim, 2025).

Two caveats complicate precise estimates of AI-driven energy demand. First, although data centers currently host the majority of AI energy use, they represent only the central node of a growing and distributed energy footprint, as inference increasingly occurs across billions of devices and applications (GSMA Intelligence, 2025). In general, AI systems distribute electricity consumption across data processing, training, and inference—the process of using a trained model to make predictions on new data. Training and large-scale processing at data centers currently account for most AI-related electricity use; inference is expected to become the main driver of demand as it is embedded in millions of everyday applications and as models grow larger and more complex (Zewe, 2025). The electricity consumed per query during inference can vary widely depending on multiple factors such as model size, input and output length, modality (text, image, or video), algorithmic efficiencies, and the type of hardware used (IEA, Energy and AI, 2025). Some studies estimate that generating an AI response may consume many times more electricity than a conventional web search, with one analysis suggesting up to 60–70 times more energy for large-scale models like BLOOM or GPT-3 (Vanderbauwhede, 2025). This shift will make energy consumption more widespread and less centralized, as inference occurs across countless user interactions rather than within only specialized facilities.

Second, even within data centers, AI workloads account for only part of the overall demand. Distinguishing AI from non-AI electricity use is increasingly hard, and no comprehensive dataset captures the share of each. There is a wide range of approximations (IEA, Energy and AI, 2025). One proxy is the use of accelerated servers[1], which accounted for 24% of server electricity demand and 15% of total data center demand in 2024 (IEA, Energy and AI, 2025).

Taking these factors into account, RAND projects that AI data centers could require an additional 10 gigawatts (GW) of capacity by the end of 2025, rising to 68 GW by 2027, nearly double global data center power requirements in 2022 (Pilz et al., 2025). Despite this rapid growth, data centers still represent a relatively modest share of global electricity use: the

IEA estimates they accounted for 1.5% of global demand—about 415 terawatt-hours (TWh)—in 2024 (IEA, Energy and AI, 2025), while Deloitte projects this will reach 2% (536 TWh) in 2025. However, if energy-intensive generative AI training and inference continue to expand exponentially, total data center consumption could reach 1,065 TWh by 2030 (Deloitte, 2024).

In LAC, the Latin American Energy Organization (OLADE) reports that there are 455 AI-related data centers. In 2023, their electricity use represented about 1.6% of the region's total demand[2]. OLADE projects that by 2035, AI could account for around 5% of regional demand, equivalent to over 120 TWh (OLADE, 2025).

This surge in electricity demand is intensifying pressure on power grids and accelerating the need for investment in low-carbon electricity generation, grid infrastructure, and transmission capacity.

3.3. Net emissions balance of AI: Increases vs. reductions

Emissions provide a measurable and policy-relevant indicator to evaluate whether AI acts primarily as an enabler of decarbonization or as a stressor on sustainability goals. According to the IEA (IEA, Energy & AI 2025), the overall impact of AI on climate outcomes depends on balancing three forces: (i) direct increases in emissions, (ii) efficiency gains and innovation, and (iii) rebound effects.

As noted in Section 3.2 on new demand, AI is already reshaping energy consumption through the rapid expansion of data centers. The IEA (IEA, Energy & AI, 2025) estimates that electricity use in these facilities accounted for about 180 MtCO_2 in 2024, around 0.5% of today's combustion-related emissions[3]. For 2035, the IEA defines two scenarios: in the base case, emissions are projected to rise to 300 MtCO_2, while in the "Lift-Off" scenario, reflecting faster AI adoption, they could reach 500 MtCO_2[4]. Although these figures remain below 1.5% of global energy emissions, their rapid growth underscores the urgency of sourcing this electricity from clean power.

At the same time, AI can cut emissions by improving efficiency across multiple processes, as discussed in Section 3.1 on AI for energy optimization. These improvements could also translate into measurable emissions reductions. Stern et al. (2025) estimate that by 2035, AI applications in just three areas (power systems, mobility, and food production) could lower global emissions by 3,200–5,400 MtCO_2 per year relative to business as usual. In line with this, the IEA (IEA, Energy & AI, 2025) projects that widespread deployment of existing AI applications could reduce emissions by roughly 5% of total energy-related emissions by 2035.

However, rebound effects may offset some of these gains. Efficiency gains from AI do not always translate into absolute emissions cuts. In some cases, they can incentivize more energy use[5]. Although there are still no robust global or regional estimates of the magnitude of these effects, both the IEA (IEA, Energy & AI, 2025) and Stern et al. (2025) highlight them as important risks that could erode AI's net climate benefits.

Overall, current evidence suggests that AI's potential to cut emissions can surpass the increases from its energy use (Stern et al., 2025), but the balance remains uncertain. The extent to which AI becomes a net contributor to decarbonization will depend on policies that guide deployment toward high-impact applications, the rapid expansion of clean energy, and governance frameworks that align its growth with decarbonization goals.

3.4. Green energy: Shifting paradigms

The rapid growth of AI underscores the need to rethink energy strategies around clean, scalable sources that can keep pace with accelerating demand.

In this context, new paradigms for renewable energy development are emerging globally. In LAC, this is an especially encouraging trend given the region's abundant solar, wind, and hydropower potential. The regional target of reaching 70% renewable electricity by 2030 reflects growing political momentum toward low-carbon development (Meza & Perez, 2022). While hydropower remains a cornerstone, countries like Brazil and Uruguay have significantly expanded wind capacity, and Chile is rapidly scaling solar generation, leveraging the Atacama Desert's exceptional irradiance (IEEE, 2022). These shifts are supported by policy instruments like clean energy auctions and grid access incentives (Giraldo, 2023), which have attracted investment and accelerated deployment, contributing to grid stability.

Globally, major AI developers are also redefining clean energy models. Technology companies have become the largest corporate buyers of renewables, often through long-term power purchase agreements (PPAs) and direct investments in clean energy infrastructure (Amazon, 2024; BloombergNEF, 2023). In the United States, the tech sector accounted for 92% of new clean energy purchases in 2024, a surge largely driven by the expansion of AI and data centers (Luccioni, 2025). Companies like Microsoft, Google, Amazon, and Meta are increasingly co-locating new data centers with dedicated clean-energy sources—solar, wind, geothermal, or nuclear—to secure a reliable low-carbon electricity supply (IEA, Energy and AI, 2024).

BOX 2 – TECH INDUSTRY DRIVING CLEAN ENERGY INNOVATION

Recent initiatives show how leading AI developers are investing directly in cleaner and more reliable energy sources to power their rapidly expanding digital infrastructure:

- To secure carbon-free electricity, Microsoft has signed a long-term power purchase agreement with Constellation Energy for 100% of the output from the Crane Research Center's nuclear power plant in the United States.

- Google is exploring more experimental approaches, including small modular nuclear reactors and next-generation geothermal projects. Through its collaboration with Fervo Energy in Nevada, Google is demonstrating how advanced drilling technologies can unlock new, cost-effective geothermal resources to power large-scale data infrastructure (IEA, Energy and AI, 2025).

3.5. Data centers: A new public–private agenda

The rapid expansion of data centers across Latin America and the Caribbean (LAC) is reshaping the region's digital landscape. As cloud computing, AI, and edge technologies proliferate, countries are positioning data centers as critical infrastructure for economic modernization and technological sovereignty. Governments are offering tax incentives, energy subsidies, and fast-track permitting to attract global players, aimed at transforming their countries into regional digital hubs (IEA, World Energy Investment, 2025).

However, this growth brings a new set of governance challenges, particularly at the intersection of energy, local infrastructure, and equity. As discussed in Section 3.2, data centers still account for a relatively small share of total emissions, yet their electricity consumption is among the fastest-growing globally (IEA, 2025). In regions where energy grids are already strained or rely heavily on fossil fuels, unregulated expansion of these facilities risks higher emissions and deepening existing energy inequalities (The Maybe, 2025). Furthermore, many communities that host data centers see limited economic or social benefit beyond short-term construction jobs, raising questions about distributive justice and long-term sustainability (The Maybe, 2025).

Addressing these issues will require a renewed public–private agenda that centers on transparency, environmental performance, and community participation. Key measures include regular reporting on energy and water use, investment to strengthen grid resilience, and linking public incentives to tangible and measurable community benefits such as workforce training, shared infrastructure, and renewable-energy integration. Aligning data center development with national decarbonization strategies and digital inclusion goals can help ensure these facilities contribute to broader development and climate objectives (IEA, Energy and AI – Analysis, 2025).

BOX 3 – MEXICO'S QUERÉTARO TECHHUB

Querétaro has rapidly become a hotspot for data center investment, with major companies like Microsoft and Amazon announcing multimillion-dollar facilities. The state's industrial base, proximity to Mexico City, and proactive government policies and incentives have attracted global interest. However, civil society groups have raised concerns about water scarcity and land use, particularly in semi-arid zones. In response, local authorities are beginning to evaluate environmental impact metrics and community consultation mechanisms (The Maybe, 2025).

3.6. Community participation: Opportunities for sustainable local development:

As digital infrastructure expands, so does the opportunity for communities to take a more active role in shaping the technologies that impact their lives. In the context of AI and energy systems, community participation is not just a normative goal, it is essential for designing resilient, just, and context-sensitive solutions (IEA, Energy and AI – Analysis, 2024).

Local communities, particularly those on the margins of formal energy access or digital services, bring critical knowledge about local ecosystems, needs, and contextual social dynamics and day-to-day realities. When engaged meaningfully, they can contribute to the design and governance of energy systems, from identifying priority areas for microgrid deployment to co-creating metrics and indicators for environmental monitoring and social impact. In AI-enabled systems, this also means engaging residents in questions about data governance, privacy, and algorithmic accountability, especially in projects involving sensors, smart meters, or public data infrastructures (Melguizo et al., 2025).

Models of participatory energy governance are already taking shape. In Brazil, community-led solar cooperatives are experimenting with AI-based monitoring tools to optimize performance and share energy savings (Microsoft, AI for Sustainability Playbook, 2024). Outside of LAC, in a Global South context, frameworks are being developed and proposed in Nigeria to integrate Indigenous communities and combine digital technologies with traditional ecological knowledge to track land-use changes and ensure that energy development does not compromise cultural or environmental integrity (Abiodun et al., 2024).

To make this form of participation standard practice, policies must ensure that engagement mechanisms are genuinely inclusive rather than extractive or symbolic. This requires allocating time and resources for capacity building, translating technical information into accessible formats, and embedding co-design practices into procurement and planning processes. Ultimately, community-driven approaches strengthen not only legitimacy and inclusion but also the long-term sustainability and efficiency of energy and AI systems.

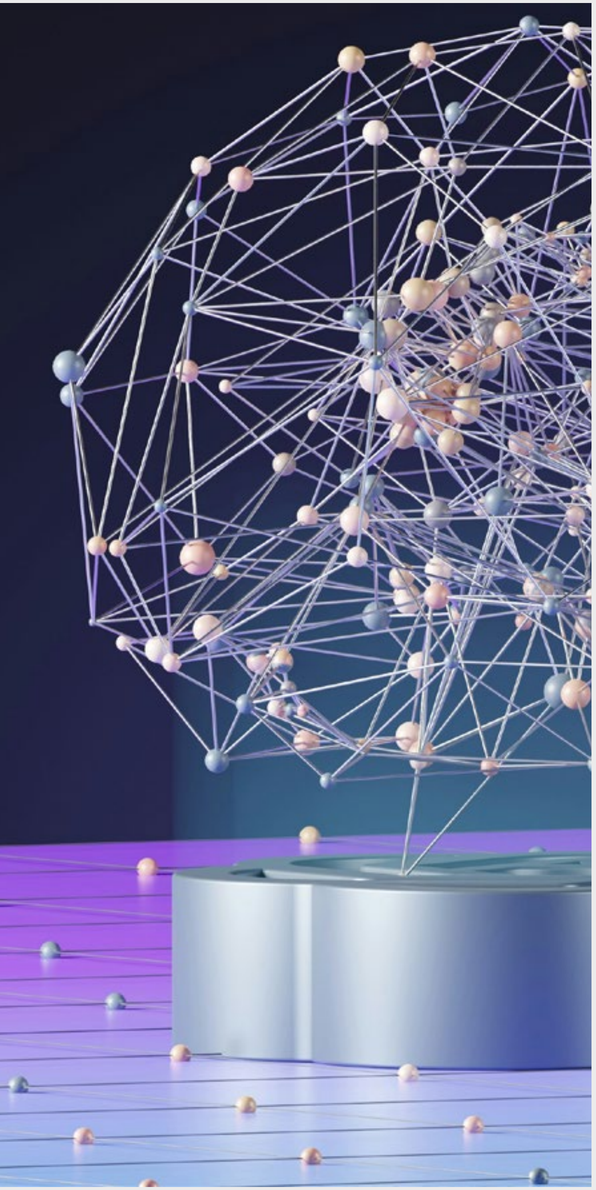
BOX 4 - DATACENTER COMMUNITY PLEDGE

In June 2024, Microsoft launched its Datacenter Community Pledge, a global commitment to ensure that the company's expanding datacenter network generates positive environmental and social outcomes in the communities where it operates. The pledge is built on three pillars:

- **Sustainability** — aiming for carbon-negative, water-positive, and zero-waste operations by 2030.
- **Community prosperity** — creating jobs, offering training, and expanding digital-skills initiatives.
- **Responsible operations** — partnering with local stakeholders and minimizing impacts such as noise, lighting, and ecosystem disruption (Walsh, 2024).

04

Recommendations & future research directions



4. Recommendations & future research directions

The integration of AI into energy systems presents both transformative opportunities and urgent challenges, underscoring the energy sector's responsibility to meet the infrastructure and emissions requirements needed to leverage AI effectively. This brief has explored how AI can optimize energy use, support decarbonization, and foster new participatory models, while warning of the risks of unchecked growth of energy-intensive infrastructure and governance gaps. Based on these findings, it outlines the following recommendations and avenues for future research.

Policy and practice recommendations

1. **Promote transparency and accountability in AI–energy systems.** Policymakers should establish clear reporting standards for the energy consumption and carbon footprint of AI applications, particularly in high-impact areas such as data centers and predictive modeling. These standards must ensure consistent, comparable, and accurate reporting across regions and sectors, include diverse stakeholder input, and effectively guide climate-aligned AI development. (IEA, Energy and AI – Analysis, 2025).

2. **Align digital infrastructure with climate and justice goals.** Incentives for AI and data infrastructure should be linked to local benefits, renewable-energy integration, and environmental safeguards. Public–private partnerships should embed social value creation, including workforce development, community reinvestment, and gender equity as core measures of success (The Maybe, 2025; IEA, 2025).

3. **Institutionalize community participation and co-governance.** Governments and the private sector should embed participatory mechanisms into AI-enabled energy planning, ensuring that marginalized communities have a voice in data collection, algorithmic decision-making, and resource allocation (Melguizo et al., 2025).

4. **Strengthen regional capacity and knowledge sharing.** Building technical and governance capacity in the Global South is essential. Priorities include fostering South-South collaboration, developing open-source tools, and supporting locally led experimentation to reduce dependency and promote context-specific solutions (Microsoft, 2024).

5. **Mandate the development of standardized AI-emissions scenarios.** Common scenarios should capture

both growth in AI-related energy demand and potential decarbonization pathways. These models should reflect regional grid mixes, infrastructure constraints, and rebound effects to provide realistic projections. Embedding such scenarios in climate-planning processes would enable more proactive policies that align AI deployment with net-zero commitments (Luers et al, 2024).

Future research directions

While promising applications of AI in energy are emerging, significant knowledge gaps remain. Advancing this field requires targeted research that centers on equity, sustainability, and context-specific innovation, particularly in underrepresented regions and communities.

- Large vs. Leaner Models: Future research should deepen comparative analysis and knowledge products between resource-intensive data centers and emerging leaner computational models, highlighting trade-offs in efficiency, equity, and sustainability.

- Global South-Led Perspectives: More documentation is needed on community-led and Indigenous innovations in AI–energy systems across Latin America, Africa, and Southeast Asia (Melguizo et al., 2025).

- AI Lifecycle Sustainability: Deeper lifecycle analysis is essential to understand the trade-offs between AI's benefits and its environmental impacts, ranging from hardware to data concerns (Luccioni et al., 2023).

- Social and Gender Impacts: Research should examine how AI in energy either mitigates or exacerbates existing inequalities, particularly around gender, rural access, and energy poverty (Global Green Skills Report, 2024).

- Ethical and Legal Frameworks: Comparative studies on algorithmic accountability, energy sovereignty, and data rights can help develop regional models for AI governance aligned with sustainability (UNESCO, 2021; The Maybe, 2025).

The convergence of AI and energy offers an opportunity to advance sustainable development if guided by equity, accountability, and foresight. As LAC builds out its digital and energy infrastructures, countries can chart an inclusive, transparent, and climate-aligned path for AI integration. By grounding innovation in local knowledge, enabling community participation in governance, and aligning technological development with social and ecological priorities, the region can lead in shaping an AI future that works for the public interest.

Endnotes

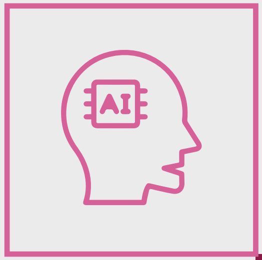
1 According to IBM, accelerated servers use specialized hardware such as graphics processing units (GPUs), application-specific integrated circuits (ASICs), or field programmable gate arrays (FPGAs) to perform tasks faster and more efficiently than traditional central processing units (CPUs). By relying on parallel computing, they are critical for advanced applications including AI, generative AI, machine learning, and high-performance computing.

2 Based on the global average energy consumption per center.

3 According to the IEA (2025), total global CO2 emissions from fuel combustion are estimated at around 35 billion metric tons in 2024.

4 For further details on these two scenarios, see Chapter 2 of the Energy & AI 2025 report by the IEA.

5 For example, lower costs in fossil fuel production enabled by AI may encourage greater extraction, and the growth of autonomous vehicles could move people away from public transport, raising transport demand and emissions.



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