Report: Water use in AI and Data Centres

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Executive summary

Growth of artificial intelligence (AI) is driving a significant, yet often underestimated, increase in water consumption, primarily for cooling data centres and generating the electricity they require. Global projections indicate that AI's water demand could reach billions of cubic metres annually, posing a substantial threat to water security worldwide and, critically, within the United Kingdom (UK).

The UK already faces a projected daily water deficit of nearly 5 billion litres by 2050[10], a challenge exacerbated by climate change and population growth. A critical policy gap exists as current national water resource plans, including those finalised in 2025 by water companies, do not adequately account for the burgeoning demand from infrastructure such as AI data centres. This oversight risks intensifying water stress in already vulnerable regions, potentially leading to social and environmental conflicts and hindering economic development.

This report provides a comprehensive analysis of AI's water footprint, its implications for UK water security, and the associated challenges and opportunities. It outlines a series of strategic actions for the UK government, directly aligned with government objectives to ensure sustainable AI development.

Key recommendations include strengthening regulatory frameworks through mandatory, location-based reporting; integrating water planning into AI infrastructure development; incentivising the adoption of advanced, water-efficient technologies; and enhancing transparency across the digital supply chain.

By proactively addressing these issues, the UK can mitigate critical risks, foster resilient digital practices, and uphold its commitment to environmental sustainability while pursuing its AI ambitions.

1. Introduction: the strategic imperative of sustainable AI in the UK

The rapid growth of AI and its resource demands

Artificial intelligence (AI) offers the promise of revolutionised industries and public services across the UK. The government has articulated an ambitious vision to position the UK as a global leader in AI, underpinned by significant investments, including a £14 billion commitment to large data centres and technology hubs, and the establishment of "AI Growth Zones" [1],.[2] This strategic emphasis on AI is seen as a vital engine for economic growth and societal advancement.

The UK's ambition to be a global leader in AI and a top destination for technology businesses [3] currently creates a direct tension with its Net Zero commitments and existing water scarcity challenges.

The rapid proliferation and increasing sophistication of AI models come with sizeable, yet often hidden, environmental implications, particularly concerning their considerable energy and water footprints. These resource demands are often underestimated by proponents of the technology. [4]

The energy consumption of AI is escalating compared to other high-energy systems.[5] For instance, energy demand from AI servers and data centres in the U.S. is projected to triple between 2023 and 2028, reaching approximately 300 terawatt-hours (TWh) annually – enough to power over 28 million American households.[4] Globally, the electricity consumption of data centres and AI servers is expected to more than double between 2022 and 2026, potentially surpassing 1,000 TWh.[4]

This immense energy demand directly correlates with a significant water footprint. Data centres, which house the computational infrastructure for AI, rely heavily on water for cooling servers. The generation of electricity to power these facilities is itself a water-intensive process, with this impact magnified when the electricity is sourced from fossil fuels [4], [6],.[7]

The observation that AI's substantial water and energy demands are frequently overlooked or under-reported indicates a systemic challenge in transparent environmental accounting within the digital sector [4],.[5] This lack of visibility directly impedes effective policy formulation, as accurate measurement is foundational to targeted intervention and accountability. Unmanaged AI growth risks undermining broader sustainability goals, necessitating a policy framework that ensures sustainable AI development, not merely rapid expansion.

UK's water landscape: current stress and future projections

The UK faces significant and growing challenges in securing its future water resources. Projections from the Environment Agency (EA) indicate a national and regional deficit in water supply across England. By 2050, a shortfall of nearly 5 billion litres of water per day is anticipated, which is equivalent to over a third of the current public water supply [8], [9],.[10] This projected deficit has been consistently highlighted by the EA, with December 2024 estimates reaffirming the 5 billion litres/day shortfall.[10]

This impending water deficit is not uniform across the country. Some regions are projected to experience less future rainfall, possess smaller water storage capacities, and face larger population or resource demands, leading to localised areas of acute water stress.[10] For instance, water-poor regions such as Sussex, Cambridgeshire, Suffolk, and Norfolk are already experiencing the impact, with housing and business growth being constrained by water supply availability and inadequate or ageing water infrastructure [8],.[9] The economic ramifications of this scarcity are substantial; the Chartered Institute of Water and Environmental Management estimates that water scarcity could cost the UK economy £25 billion over the next five years due to halted housing developments alone [9],.[10]

The existing and projected UK water scarcity, driven by climate change, population growth, and infrastructure issues, creates a highly vulnerable context into which AI's additional water demand is being introduced. This situation is not merely adding to an existing problem; it is exacerbating an already critical national challenge. The EA's concerns regarding the resilience of water companies' plans following the record-breaking 2022 drought, which was England's hottest summer and driest since 1995, underscore the UK's existing vulnerability to climate change impacts.[9] AI's water demand, particularly for cooling during heatwaves, directly intensifies this vulnerability, creating a feedback loop where climate change increases the demand for water-intensive cooling, further stressing supplies during periods of peak demand and low availability.

The projected deficit is not solely a supply problem but intersects with crucial environmental protection goals, such as maintaining sufficient water flows to support natural ecosystems.[10] It also directly impacts economic development, as evidenced by the halted housing projects.[9] AI's water footprint, therefore, adds another layer of complexity to an already multi-faceted policy challenge, demonstrating that water is not merely an environmental concern but a fundamental constraint on economic development and social well-being.

Report objectives and alignment with GDSA mandates

This report aims to provide a comprehensive analysis of the water footprint of artificial intelligence and data centres in the UK, assessing its impact on national water resources and identifying associated risks and opportunities. It seeks to inform and support the UK government in developing robust policies and strategies for sustainable digital practices, particularly within its own Information and Communication Technology (ICT) estate.

The recommendations presented are specifically aligned with the objectives of the Government Digital Sustainable Alliance (GDSA). Key GDSA mandates include identifying key risks and opportunities in the procurement and operation of government's ICT estate that support sustainable digital practices and providing expertise and feedback for policy and strategy development.

2. The water footprint of AI

Understanding water consumption in AI data centres (cooling, energy generation, chip manufacturing)

Data centres, which are the foundational physical infrastructure for artificial intelligence, consume water through three primary mechanisms: cooling, electricity generation, and the manufacturing of semiconductor chips.[6] Each of these processes contributes to the overall water footprint of AI, with varying degrees of direct control by data centre operators.

Cooling Systems

This represents the most direct and substantial water consumption within data centres themselves. Servers, which are required for AI training and inference, generate significant heat, necessitating efficient cooling systems to maintain optimal operating temperatures and prevent overheating.[6] A common method, evaporative cooling, dissipates heat through both heat transfer (to air without evaporation) and latent heat transfer (with evaporation), but crucially, around 80% of the water used in this process is lost to evaporation, requiring continuous replenishment with fresh water. [13] This replenishment often utilises potable (drinking quality) water to prevent clogging of pipes, pumps, and heat exchangers with contaminants.[9] The constant demand for fresh water to cool these systems means that data centres can significantly lower water levels and impact fish and other aquatic ecosystems in the surrounding areas.[4]

Electricity Generation

Beyond direct cooling, the significant quantities of electricity required to power AI and data centres carry a substantial embedded water footprint. The process of generating electricity, particularly from fossil fuels, is inherently water-intensive [4],.[6] This indirect water consumption is often overlooked but can be as significant as, or even greater than, the direct cooling needs. For instance, a typical large data centre's daily water usage estimates often do not include the water consumed by the power generation facilities that supply it.[7] This highlights that a holistic view of AI's water impact must extend beyond the data centre perimeter to encompass the entire energy supply chain. The reliance on fresh, mains (potable) water for cooling creates a direct competition with public drinking water supplies, making data centres vulnerable to water restrictions during droughts and potentially exacerbating social conflicts in water-stressed areas.[9]

Semiconductor Chip Manufacturing

The production of the advanced semiconductor chips essential for AI hardware is another water-intensive process. Chip fabrication requires ultrapure water to rinse residue from silicon wafers during various stages of the manufacturing process.[6] While data centre operators have comparatively less direct control over this upstream water consumption, it contributes to the overall embodied water footprint of AI infrastructure. This underscores the need for a comprehensive approach to sustainable AI, considering its full lifecycle environmental impact.

Global and UK water consumption statistics for AI and data centres

The scale of water consumption by AI and data centres is significant and rapidly increasing, posing a global challenge with direct implications for the UK.

Globally, the International Energy Agency (IEA) estimates that the data centre sector consumes over 560 billion litres of water annually. Projections indicate this figure could rise dramatically, reaching as high as 1,200 billion litres by 2030.[13]

The impact of individual hyperscale data centres is even more pronounced, with a 100MW facility capable of consuming around 2.5 billion litres of water annually, equivalent to the needs of approximately 80,000 people.[14]

Leading technology and hyperscale data centre providers, at the forefront of AI development, have reported substantial year-on-year increases in their data centre water consumption. Microsoft's global water use, primarily for its cloud data centres, increased by 34% in 2022, reaching 6.4 million cubic metres. Google's data centres consumed 19.5 million cubic metres of water in 2022, marking a 20% increase [5], [9],.[15] These figures demonstrate the escalating demand driven by AI workloads.

The immense scale of water consumption, often expressed in billions of litres or comparisons to large populations, is striking, yet this impact has often "gone unnoticed".[8] This disparity between the actual environmental burden and public or policy perception highlights the critical need for clear, relatable communication in this report to effectively inform policymakers. The consistent year-on-year increases in water consumption by major tech companies underscore that voluntary efforts alone may be insufficient without robust regulatory pressure, particularly given the acknowledged lack of reliable data on overall data centre resource use across the industry [5],.[14]

Projections and trends

The trajectory of AI's water footprint indicates a rapidly escalating challenge. Based on projected demand growth, AI tools could indirectly lead to global water withdrawals of between 4.2 billion and 6.6 billion cubic metres by 2027 [8],.[14] To put this into a UK context, this global demand is equivalent to roughly half of the UK's annual water consumption [8],.[14] This projection directly translates the global problem into an imminent, UK-relevant crisis, demanding immediate and strategic policy attention.

The growth of AI systems and services is occurring at a rate "unparalleled by other high-energy systems," and notably, "generally without much regard for resource efficiency".[5]

This observation points to a significant market failure: the rapid expansion of AI has prioritised computational power and deployment speed over environmental sustainability. The efficiency trends in compute growth will strongly influence future water footprints.[16] This means that if current practices continue, the water demand will rise dramatically, but if efficiency improvements are prioritised and mandated, the impact could be mitigated.

The strong language used to describe AI's growth lacking "regard for resource efficiency" [5] indicates a fundamental flaw in the current development trajectory of the industry. This is not merely an issue of individual company practices but reflects a collective approach that prioritises scale over sustainability. This situation necessitates government intervention to correct this market failure through targeted regulation and incentives for efficiency improvements.

Metric	Data Point	Significance for AI Water Use	Source
Water per kWh of Energy	Up to 2.4 gallons per kWh	Directly links energy consumption to water use, highlighting the impact of inefficient energy sources.	[4]
Daily Water for Average 100MW Data Centre	~2 million litres	Provides a tangible daily consumption figure for a common data centre size.	[13]
Annual Water for 100MW Hyperscale Data Centre	~2.5 billion litres (equivalent to needs of 80,000 people)	Highlights the concentrated demand of large-scale AI infrastructure.	[14]
Global AI Water Demand (by 2027)	4.2-6.6 billion cubic metres (equivalent to ~half of UK's annual water consumption)	Directly contextualises the global problem for the UK, underscoring the urgency of national action.	[8], [14]
Microsoft Water Consumption (2022)	6.4 million cubic metres (34% increase from 2021)	Demonstrates the rapid increase in water use by leading tech companies.	[5]
Google Water Consumption (2022)	19.5 million cubic metres (20% increase from 2021)	Further evidence of escalating water demands from major AI and cloud providers.	[5]

3. AI's impact on UK water resources: challenges and risks

National and regional water supply deficits in England (Environment Agency projections)

The UK's existing vulnerability to climate change impacts is a critical factor. The EA has expressed concern about the resilience of water companies' plans following the extreme weather events of 2022, which saw England experience its hottest summer on record and driest period since 1995.[9] This period of high demand and low supply led to some water companies resorting to emergency measures like tankers and bottled water to maintain continuity of supply.[9] The introduction of AI's water demand, particularly for cooling during heatwaves, directly exacerbates this vulnerability. This creates a dangerous feedback loop where climate change-induced heatwaves increase the need for water-intensive cooling, further stressing water supplies during the very periods when resources are most constrained.

The projected water deficit is not solely a supply problem but intersects with broader environmental protection goals, such as maintaining sufficient water levels to support natural ecosystems.[10] It also has direct economic consequences, as evidenced by the estimated £25 billion cost to the UK economy over the next five years due to halted housing developments caused by water scarcity [9],.[10] AI's water footprint adds another layer of complexity to an already multi-faceted policy challenge, demonstrating that water is not merely an environmental concern but a fundamental constraint on economic development and social well-being.

Metric	Data Point	Significance	Source
Current Public Water Supply (England)	~14,000 billion litres/day (14,000 Ml/d)	Baseline for public water availability.	[10]
Projected Daily Deficit by 2050 (England)	Nearly 5 billion litres/day (5,000 Ml/d)	Quantifies the severe future water shortage, indicating the urgency of intervention.	[8], [9], [10]
Deficit as Proportion of Current Supply	Over a third	Highlights the substantial scale of the projected shortfall relative to current consumption.	[9], [10]
Economic Cost of Water Scarcity (UK, next 5 years)	£25 billion (due to halted housing developments)	Demonstrates the direct economic impact of water scarcity, linking environmental concerns to economic stability.	[9], [10]

Identification of seriously water stressed areas in the UK

The 2021 determination of water stressed areas in England provides a crucial geographical map of vulnerability. Numerous regions have been classified as "seriously water stressed" for metering purposes, indicating existing and projected pressures on water resources.[18] These areas are served by water companies including:

- Affinity Water
- Anglian Water – East Anglia
- Essex and Suffolk Water
- South East Water
- Southern Water
- Thames Water
- Cambridge Water
- Portsmouth Water
- South Staffordshire Water
- South West Water – Bournemouth
- South West Water – Isles of Scilly

The concentration of data centres in specific regions, such as Greater London, further intensifies the impact of localised climate risks like heatwaves and water stress.[19] This overlap between areas designated as "seriously water stressed" and proposed or existing data centre clusters creates predictable "conflict hotspots." For example, the first government-designated "AI Growth Zone" in Culham, Oxfordshire, is situated just seven miles from the site of a planned new reservoir at Abingdon, intended to supply customers in the Thames Valley, London, and Hampshire.[9] Thames Water, the utility responsible for this area, is itself classified as seriously water stressed.[18] This direct geographical overlap means that policy decisions about data centre location are critical to avoiding exacerbating existing water crises and potential social unrest.

The siting of water-intensive infrastructure in already water-stressed areas, particularly those with existing socio-economic vulnerabilities, raises significant environmental justice concerns. This practice could disproportionately impact local communities, potentially leading to increased water bills, rationing, or reduced environmental flows, thereby transforming a technical water management issue into a matter of social equity.

The unaccounted demand: data centres in current water resource planning

A critical oversight in current UK water resource planning is that the measures proposed by water companies to meet the projected 2050 deficit *do not account for the water needs of novel infrastructure or data centres*.[10] This represents a systemic planning failure, indicating a disconnect between the nation's digital economy growth ambitions and its fundamental resource management strategies.

The Environment Agency has acknowledged that future demand from new technologies like AI and data centres is "highly uncertain" and makes water resources more difficult to plan for.[9] The EA has urged data centres to forecast and plan their water consumption, and to explore their own sources, such as water reuse, due to the current insufficiency of data for comprehensive future planning. This reliance on industry self-reporting, however, is challenged by a pervasive lack of transparency. There is currently "no reliable data on the quantity of resources used by data centres" [5], and only two-fifths of data centre operators actively track their water usage metrics.[14] This fundamental transparency deficit is a major barrier to effective governance and accountability, making it impossible to accurately measure, manage, or regulate AI's water impact. Without comprehensive and reliable data, the problem cannot be accurately quantified or effectively addressed through policy.

Socio-environmental implications: biodiversity, local communities, and water security

The impact of AI's water consumption extends beyond mere quantitative resource depletion to significant socio-environmental consequences, affecting both biodiversity and local communities. Water abstraction, including for data centres, can exacerbate the impacts of drought on UK river biodiversity [20],.[21] This can lead to declines in diverse aquatic communities, from microbes to fishes, with particular losses of sensitive species such as riverflies.[20] In a warming world, hotter, drier, and faster-onset droughts, can push more native species beyond their tolerance thresholds, potentially allowing invasive and other competitive generalist species to thrive at the expense of overall biodiversity.[20]

The continuous replenishment of cooling water, often drawn from fresh water sources, directly lowers water levels in surrounding areas and negatively impacts fish and other water ecosystems.[4] This elevates the issue from a resource management problem to an ecological crisis, aligning with broader UK environmental goals to protect and enhance natural capital.

If left unaddressed, the growing demand for water from AI could lead to significant social and environmental conflicts. International precedents exist where local communities have actively opposed data centre developments due to concerns over water availability [9],.[13] The exploitation of groundwater for various purposes—drinking water, agriculture, and industry—already creates "colliding interests," intensifying competition for a finite resource.[21] The introduction of large-scale, unaccounted data centre water demand into this competitive landscape is likely to exacerbate these tensions.

The potential for "social and environmental conflicts" [8] and local community opposition [9], [13] highlights that data centres' operations are not just technical or economic but also have a significant social dimension. Losing public trust due to perceived or actual impacts on local water supplies can hinder development and create political friction, regardless of the Critical National Infrastructure (CNI) status granted to data centres. This implies that securing a "social license to operate" through transparent and sustainable water practices is paramount for the long-term, stable development of AI infrastructure in the UK.

4. UK policy and regulatory framework for sustainable digital practices

Existing UK water legislation and policy (Environment Act 2021, Water Resources Management Plans)

The UK has established a legislative and policy framework for water management, which provides a foundation for addressing AI's water footprint, though significant gaps remain. The Environment Act 2021 sets a national statutory target to reduce per capita water use by 20% by 2037-2038 from the 2019-20 baseline. It also includes an interim target to reduce non-household water use by 9% by 2030 [8],.[22] However, current plans indicate a shortfall in achieving this business target, with only a 6.1% reduction achieved so far.[8] This disparity between targets and current achievement indicates a policy implementation challenge that needs to be addressed.

Water companies in England are legally required to produce statutory Water Resources Management Plans (WRMPs), outlining how they will plan for future water resources over the next 25 years. The latest iteration of these revised WRMPs was summarised in December 2024 and is expected to be finalised in 2025 [9],.[10] Critically, these plans, designed to meet projected deficits, *do not account for the water needs of novel infrastructure or data centres* [9],.[10] This explicit exclusion represents a systemic planning failure and a significant disconnect in strategic planning across government departments (e.g., digital/tech versus environment/water).

The government is also set to publish its next iteration of the national framework for water resources in 2025.[9] This framework will set out England's long-term water needs and the scale of action required to ensure resilient future supplies. This upcoming publication, alongside the finalisation of WRMPs, presents a critical and immediate policy window to integrate data centre water demand explicitly into national water planning [9],.[22] The urgency of these 2025 policy windows means that the recommendations within this report are timely and can directly influence these foundational water policy documents.

Greening government commitments and ICT strategy (2020-2025)

The UK government has internal policy frameworks aimed at promoting sustainable practices within its own operations. The Greening Government Commitments (GGCs), launched in 2011, aim to embed sustainable development principles in the procurement and operation of all central government departments, including targets for reducing waste, water use, and greenhouse gas emissions.[23]

The Greening Government ICT Strategy (2020-2025) further elaborates on these commitments for the digital sector. It outlines five key outcomes: reduced carbon and costs, increased resilience, increased responsibility (doing the right thing), increased transparency and collaboration, and increased accountability [11],.[24] This strategy mandates that ICT suppliers commit to science-based net zero targets and promotes circular ICT policies, encouraging products designed for durability, ease of maintenance, and recycling.[24] The strategy also encourages rationalising the ICT estate, consolidating servers and data centres, and utilising cloud services to reduce energy and costs, while adhering to best practices like the EU Code of Conduct for energy efficiency.[23]

These existing GGCs and the Greening Government ICT Strategy provide a robust framework and established policy levers for addressing sustainability within government's own digital operations. The challenge lies in explicitly integrating water efficiency and AI-specific considerations into these existing commitments. The government's significant procurement power, highlighted by the GGCs' emphasis on engaging suppliers and purchasing sustainable, efficient products [23], [24], represents a powerful tool to drive water efficiency standards throughout the digital supply chain. Work is currently underway by Defra to finalise the Government Digital Sustainability Strategy for 2025-2030, with direct input from GDSA working groups.[11] This ongoing development presents a prime opportunity to embed specific water consumption targets and requirements for government ICT infrastructure and procurement.

GDSA objectives: identifying risks and opportunities in government ICT

The Government Digital Sustainability Alliance (GDSA) serves as a collaborative platform, bringing together specialists from government and its digital and data suppliers, as well as academics and third sector organisations. Its core purpose is to promote and advance knowledge and capabilities for sustainable digital data and technology across UK Government and its suppliers.

The GDSA's structure, which includes dedicated working groups such as Planetary Impact working group and the AI working group, is directly relevant to assessing and mitigating the environmental footprint of digital technology. These groups provide a forum for identifying key risks and opportunities in the procurement and operation of government's ICT estate that support sustainable digital practices, aligning directly with the objectives of this report. The GDSA‘s role in developing and promoting best practice, solutions and guidance for strategic challenges makes it a vital conduit for the findings and recommendations presented here.

The GDSA's collaborative approach, involving both government and suppliers, offers a practical mechanism for developing and implementing solutions. This multi-stakeholder engagement can facilitate the co-creation of practical solutions and help overcome barriers to digital sustainability, leading to more effective policy implementation. Furthermore, the GDSA's Scope 3 working group, which focuses on reducing the carbon footprint of the digital supply chain, provides a direct parallel for addressing the *indirect* water footprint of AI. This includes water used in upstream processes like chip manufacturing or in the generation of electricity by suppliers, extending government influence beyond its direct operational control.

Legislation/Policy	Key Provisions Relevant to Water Use in ICT/Data Centres	Significance for AI Water Footprint	Source
Environment Act 2021	Sets national statutory targets for water use reduction: 20% per capita by 2037-38; 9% non-household by 2030 (current plans fall short at 6.1%).	Provides overarching legal framework for water conservation, but current business targets are not being met, indicating a need for stronger enforcement or incentives for sectors like AI.	[8], [22]
Water Resources Management Plans (WRMPs)	Statutory plans by water companies for 25-year outlook; latest iteration finalised 2025. *Crucially, current plans do not account for water needs of novel infrastructure or data centres.*	A critical policy gap. AI's water demand is not integrated into long-term national water planning, risking future deficits and conflicts.	[9], [10]
National Framework for Water Resources (2025)	Sets England's long-term water needs and actions for resilient supplies; highlights need for joined-up planning between water-using sectors.	A key policy window in 2025 to integrate AI data centre water demand into national water strategy.	[9], [22]

Greening Government Commitments (GGCs)	Embeds sustainable development in central government procurement and operation, including reducing water use.	Provides an existing internal mechanism for the government to lead by example in sustainable ICT procurement and operation, including water efficiency.	[23]
Greening Government ICT Strategy (2020-2025 / 2025-2030)	Targets for reduced carbon/costs, increased resilience, responsibility, transparency, accountability in government ICT; mandates supplier commitment to science-based net zero targets.	Establishes a framework for sustainable government ICT. The 2025-2030 update is an opportunity to explicitly include water efficiency targets for government data centres and AI services.	[24]
Government Digital Sustainability Alliance (GDSA)	Collaborative body for sustainable digital practices across government and suppliers; feeds recommendations into policy and strategy.	A direct conduit for influencing policy. Its Planetary Impact and AI working groups are ideally positioned to address AI's water footprint.	
Critical National Infrastructure (CNI) Designation for Data Centres (Sept 2024)	Places data centres on equal footing with water, energy, and emergency services; aims to boost investment and resilience; implies fewer planning restrictions.	Creates a policy tension, prioritises data centre operation but potentially undermines water companies' ability to manage supply in stressed areas, increasing government responsibility for sustainable operation.	[2], [9], [25], [26]
Ofwat Price Review (2024)	Sets water company bill increases and funding mechanisms for WRMPs.	Influences water company investment in infrastructure and demand management, which could be directed towards supporting sustainable	[9]

		data centre water supply (e.g., non-potable sources).	

Calls for mandatory reporting of AI/data centre water use and government stance

A consistent and urgent call from experts is for the UK government to mandate comprehensive reporting of AI and data centre resource consumption. Organisations such as the National Engineering Policy Centre (NEPC) have strongly urged the UK government to require tech companies to submit mandatory reports on their energy, water consumption, and carbon emissions for data centres [5],.[15] This recommendation stems from the observation that AI systems are expanding rapidly without sufficient regard for resource efficiency, and crucially, there is currently "no reliable data on the quantity of resources used by data centres".[5] This fundamental transparency deficit is a major barrier to effective governance and accountability, making it impossible to accurately measure, manage, or regulate AI's water impact.

Despite significant year-on-year increases in water consumption reported by leading tech companies like Google and Microsoft since 2020 (e.g., Microsoft's 34% increase in 2022, Google's 20% increase in 2022) [5], [15], overall industry transparency remains low, with only two-fifths of data centre operators actively tracking their water usage metrics.[14] Many of these withdrawals are from potable sources.[5] The European Union has already implemented mandatory disclosure of water consumption for data centre operators under its Common Union Rating Scheme, providing a clear precedent and model for the UK to follow [27],.[28] This EU approach demonstrates that mandatory, location-based reporting is feasible and necessary to ensure accountability and inform policy.

The UK government has acknowledged that data centres "face sustainability challenges" regarding energy demands and water use.[9] Government spokespersons have stated that "AI Growth Zones are designed to attract investment in areas where existing energy and water infrastructure is already in place".[9] However, this stance appears to be more aspirational or reactive rather than a proactive, mandated policy. The Environment Agency, recognising the insufficient data for future planning, is currently urging data centres to forecast and plan their water consumption and explore their own sources, such as water reuse.[9] This approach places the burden primarily on industry rather than establishing a clear, comprehensive regulatory framework for data collection and reporting. This highlights a gap between governmental recognition of the challenge and the implementation of robust, mandated policy actions.

Data centres as critical national infrastructure: implications for water supply and planning

In a significant policy shift, the UK government officially designated data centres as Critical National Infrastructure (CNI) in September 2024 [2], [9], [25],.[26] This classification places them on an equal footing with essential services such as water, energy, and emergency services systems. The primary aim of this designation is to boost business confidence, attract substantial investment and ensure greater government support for recovery from critical incidents. A perceived implication of this status is fewer planning restrictions for data centre developments [2],.[9]

This CNI designation has profound implications for water supply and planning. Previously, water companies like Thames Water had no legal obligation to service businesses and could, in principle, restrict water supply during periods of scarcity. Thames Water, for example, had warned data centres of potential restrictions during heatwaves and even objected to planning applications for new data centres due to water concerns.[9] However, the CNI status now effectively overrides these previous stances, meaning data centres will likely face fewer restrictions on water access, even in water-stressed areas.[9]

This creates a direct and immediate policy tension: the government's drive for AI growth and the CNI designation for data centres potentially conflict with existing water scarcity challenges and the ability of water companies to manage supply equitably in stressed regions [9],.[15] This policy incoherence could lead to unintended consequences for public water supply and environmental flows, particularly in areas already experiencing severe water stress.

With data centres now classified as CNI, the government assumes a heightened responsibility not only for their operational resilience but also for ensuring their *sustainable* operation, particularly concerning water. This implies that CNI status should be accompanied by stringent environmental sustainability requirements, not merely operational priority. The government's decision to grant CNI status means it has a direct stake and responsibility in ensuring these critical infrastructures do not become a liability to national water security or exacerbate existing environmental justice concerns.

5. Opportunities for sustainable AI development and water resource management

Despite the significant challenges, there are substantial opportunities for the UK government to foster sustainable AI development and enhance water resource management through strategic policy interventions, technological adoption, and collaborative initiatives.

Leveraging advanced cooling technologies and water recycling

Advancements in cooling technologies offer potential for reducing water consumption in data centres. Traditional air-cooling systems are generally less efficient on energy and may not be suitable or appropriate for AI servers.[29] In contrast, liquid cooling solutions, such as Direct to Chip (DTC) cooling and some forms of immersion cooling, offer superior heat transfer capabilities, capturing much of the heat produced [6],.[29] According to Microsoft, cold plate and some immersion cooling technologies can reduce water usage by 31% to 52% compared to traditional air cooling over their entire life cycles [13],.[14] While they may involve higher upfront capital expenditure, they often lead to long-term operational expenditure savings.[6]

Beyond efficiency, many data centres are increasingly recycling water within their cooling systems to reduce environmental impact and promote sustainability.[29] This includes the use of closed-loop systems that minimise fresh water use by reusing the same water multiple times. Leading companies like Microsoft have developed "zero-water evaporation cooling designs" that can save significant water volumes annually [8].

Data centres can reduce their reliance on potable (drinking quality) water by utilising alternative sources. Non-potable water, such as industrial or agricultural wastewater, can be treated minimally and used effectively for cooling processes, thereby reducing the strain on municipal drinking water supplies [22], [29]. Rainwater harvesting and greywater recycling also offer environmentally friendly and renewable solutions for cooling and facility maintenance [14], [29]. Google, for example, relies on non-potable wastewater at 25% of its campuses. The explicit recognition that water for cooling systems "does not need to be drinking water quality" [22] is a crucial technical detail that can inform policy on promoting non-potable water sources.

Hybrid cooling systems, which primarily use air for cooling but switch to water only during peak heat periods, offer a balanced approach to optimising both energy and water efficiency, particularly in water-stressed regions.[29] Intelligent pumps with variable temperature controls can further optimise cooling systems by dynamically adjusting to daily cooling loads, preventing overcooling and wasted resources.

Strategic site selection and water-energy planning

The location of new data centres is paramount for sustainable development. Strategic site selection must consider the availability and source of water resources, ensuring they can sustain cooling needs without harming the environment or local populations [7]. This requires early assessment of local water infrastructure capacity similar to how energy availability is assessed.[7]

There is a significant and often overlooked "water-energy nexus" in data centre operations, where the demands for both resources are intertwined.[7] Approximately 20% of water used in data centres comes from water-stressed watersheds.[7] Integrated planning for both energy and water infrastructures, including co-location where feasible, can optimise resource use and efficiency.[7] The Environment Agency's upcoming National Framework for Water Resources (2025) highlights the need for "joined-up planning between different water-using sectors" to identify collaborative solutions.[22] This provides a timely opportunity for the government to mandate comprehensive water impact assessments as a prerequisite for data centre development, especially within designated AI Growth Zones.

Enhancing transparency and data-driven policy

The current lack of reliable and comprehensive data on data centre water consumption is a significant barrier to effective policy. Only two-fifths of data centre operators actively track water usage metrics [14], making it difficult to formulate effective policies to reduce their environmental footprint.[5] Experts are urging for mandatory reporting of AI data centres' energy and water use, arguing that access to "trustworthy data" is crucial for targeting efficiency and planning a sustainable AI future for the UK.[5]

The EU's mandatory disclosure of water consumption for data centre operators under its Common Union Rating Scheme [27], provides a clear precedent for the UK. Such a scheme should require location-based reporting of resource consumption, separated from water stewardship programs that may compensate for water consumed without replenishing it in the affected areas.[27] This approach would ensure genuine local impact mitigation and prevent greenwashing.

Accurate data and water risk assessments are crucial for managing water risks. Operators should use water risk assessment tools to evaluate site conditions, identify high-stress areas, and guide site selection and mitigation strategies.[29] AI-driven optimisation can also play a role, adjusting cooling in real-time to ensure no more water (or energy) is used than necessary.

AI as a tool for water management and environmental protection

While AI contributes to water demand, it also holds immense potential as a powerful tool for water management and broader environmental protection. AI technologies can expedite scientific advances, improve energy efficiency, and inform disaster response.[32]

Specifically in water science and technology, AI can be leveraged for different purposes. This dual nature of AI, as both an environmental burden and a potential environmental solution, needs to be carefully balanced in policy. Government investment in research and development for AI applications in water management and environmental monitoring can unlock significant benefits for the UK.

Pollution detection and monitoring

New AI technology helps scientists detect harmful pollutants in England's lakes, identify at-risk species, and analyse complex data to find links between pollutants and biodiversity loss.[30] AI can detect chemicals that continue to cause harm due to their persistence in the environment.[30]

Water quality and quantity forecasting

AI can generate complex forecasts to model future scenarios in real-time, aiding in flood management, storm responses, and predicting environmental processes like erosion and landslides.[32]

Optimising water infrastructure

AI can be used for electricity grid management, optimising supply and demand for energy, which indirectly reduces the water footprint of energy generation.[32]

Environmental regulation enforcement

AI can be remarkably effective at forecasting which facilities are likely to be violating environmental regulations, improving the detection of water pollution violators by over 600% compared to random selection.[32]

Incentivising sustainable practices and public sector leadership

Government incentives can play a crucial role in driving the adoption of water-efficient technologies and practices in the data centre sector. While the UK government has invested significantly in AI infrastructure, specific grants or tax breaks for water-saving data centres are not clearly articulated. Existing mechanisms, such as Ofwat's tiered discounts for water efficiency in new homes (e.g. for rainwater harvesting and greywater recycling) [31], could serve as a model for commercial and industrial users like data centres. The upcoming Ofwat engagement with the industry from 2025 on environmental incentives for developer services presents a direct opportunity to influence water companies to offer specific, effective incentives for data centres.

The UK government, through its own ICT procurement and operation, has a significant opportunity to lead by example. The Greening Government Commitments and the Greening Government ICT Strategy already provide a framework for embedding sustainable development principles [23],.[24] By setting stringent water efficiency standards for its own data centres and cloud services, and by prioritising suppliers who demonstrate best practices in water management, the government can stimulate market demand for sustainable solutions. This includes requiring detailed water consumption reporting from its suppliers and favouring those who use non-potable water sources or implement advanced cooling technologies.

Community engagement and other water initiatives are also vital. Data centres should collaborate with local governments, utilities, and communities, sharing usage data transparently, joining stewardship initiatives, and funding regional water projects to offset consumption and enhance water security.[29] This fosters public trust and ensures sustainable water use, particularly in the context of data centres being designated as Critical National Infrastructure.

6. Conclusions and recommendations for government action

The rapid expansion of AI presents a profound challenge to the UK's water security and environmental sustainability. The evidence demonstrates that AI's substantial water footprint, primarily driven by data centre cooling and energy generation, is escalating at an alarming rate and is largely unaccounted for in current national water resource planning. This critical oversight, coupled with existing and projected water deficits in the UK, creates a significant risk of exacerbating water stress, leading to potential social and environmental conflicts. The recent designation of data centres as Critical National Infrastructure, while intended to bolster digital resilience, further highlights the government's heightened responsibility to ensure these facilities operate sustainably.

However, this challenge also presents a strategic opportunity for the UK to lead in sustainable digital governance. By proactively addressing AI's water footprint, the government can mitigate future risks, enhance resource resilience, and align its digital ambitions with its Net Zero and environmental protection commitments.

To support the key objectives of the Government Digital Sustainability Alliance (GDSA) identifying key risks and opportunities in the procurement and operation of government's ICT estate which support sustainable digital practices, and providing expertise and feedback for policy and strategy development, the following actionable recommendations are presented for the UK government and public sector:

Recommendation 1: Mandate comprehensive and location-based water reporting for data centres

Action

Introduce legislation requiring all data centres operating in the UK, particularly those above a certain power threshold (e.g. 1MW), to submit mandatory, granular reports on their energy, water consumption (distinguishing between potable and non-potable sources), and carbon emissions. This reporting should be location-specific to identify and manage localised water stress.

Rationale

The current lack of reliable data is a fundamental barrier to effective policy [5],.[14] Mandatory reporting, as demonstrated by the EU's Common Union Rating Scheme [27], is essential for transparency, accountability, and informed decision-making. This directly supports the objective of increasing transparency and accountability in government ICT.[12]

Recommendation 2: Integrate AI and data centre water demand into national water resource planning

Action

Amend the scope of the upcoming National Framework for Water Resources (2025) and future Water Resources Management Plans (WRMPs) to explicitly account for the projected water needs of novel infrastructure, including AI data centres [9], [10],.[22] This requires close collaboration between Defra, the Environment Agency, Ofwat, and the Department for Science, Innovation and Technology.

Rationale

The current exclusion of data centre water needs from national planning is a critical systemic oversight [9],.[10] Integrating this demand is crucial to avoid future water deficits and ensure long-term water security, directly addressing a key risk identified in this report.

Recommendation 3: Implement water efficiency standards and incentives for data centres

Action

Establish clear environmental sustainability requirements for all new and existing data centres, with a specific focus on reducing the use of potable water for cooling and moving towards "zero use for cooling" of drinking water [9],.[22] This should include mandating the adoption of advanced cooling technologies (e.g., liquid immersion, direct-to-chip, dry cooling) and the preferential use of non-potable water sources (e.g., recycled wastewater, rainwater harvesting) [6], [14], [29].

Action

Explore and implement targeted government incentives, such as grants, tax breaks, or streamlined permitting processes, for data centres that adopt water-saving technologies and practices [19]. Leverage Ofwat's engagement with the industry on environmental incentives to encourage water companies to offer specific discounts for water-efficient data centres.

Rationale

Advanced cooling and water recycling technologies are proven to significantly reduce water consumption [6], [13]. Incentives are necessary to overcome higher upfront capital costs and accelerate adoption.[6] This supports the aim to reduce environmental impact and increase resilience in the ICT estate.

Recommendation 4: Prioritise sustainable site selection for AI growth zones and data centres

Action

Mandate comprehensive water availability assessments as a prerequisite for the development of new data centres, particularly within government-backed AI Growth Zones. Prioritise locations with demonstrable water surpluses or access to abundant non-potable water sources, avoiding areas already classified as "seriously water stressed" [7], [9], [18].

Rationale

The clustering of data centres in water-stressed regions exacerbates local water scarcity and risks social conflict.[19] Proactive site selection is crucial to prevent further strain on vulnerable water supplies and ensure the long-term viability of AI infrastructure. This directly addresses the objective of identifying key risks in procurement and operation.

Recommendation 5: lead by example through sustainable government ICT procurement and operation

Action

Strengthen the Government Digital Sustainability Strategy (2025-2030) to include explicit, quantifiable water efficiency targets for government-owned and procured data centres and AI services. Require government suppliers to demonstrate adherence to these water efficiency standards, including reporting on their water usage and commitment to using non-potable sources [11], [23],.[24]

Action

Invest in the development and adoption of AI as a tool for water management and environmental protection within government operations, such as for pollution detection, water quality forecasting, and optimising water infrastructure [30],.[32]

Rationale

The government's significant ICT footprint and procurement power provide a powerful lever to drive market transformation towards sustainable digital practices.[23] Demonstrating leadership in water efficiency within its own estate aligns with the mandate to promote best practices and increase responsibility and accountability.

Final words on recommendations for government action

By implementing these recommendations, the UK government can ensure that its ambitious pursuit of AI leadership is underpinned by robust environmental stewardship, safeguarding vital water resources for both current and future generations, and solidifying its position as a global leader in sustainable digital governance.

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