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The impact of AI on the environment

Part of Greater Manchester
Integrated Care Partnership

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Introduction

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- AI is a rapidly emerging technology and can be found increasingly in everyday products, from smartphones to washing machines.
- There is also increasing interest around how AI can improve the efficiency of public services, including in the NHS. There was a significant focus on AI at the NHS Confed 2025.

'The potential of AI to transform public services is enormous, giving us an unparalleled opportunity to do things differently and deliver more with less. AI is already helping civil servants spend less time on repetitive tasks, enabling teachers to personalise lessons, and can allow doctors to access life-saving insights faster, through AI-assisted diagnostics.'

*Forward -*Artificial Intelligence Playbook for the UK Government (HTML) - GOV.UK

Feryl Clark MP

Parliamentary Under-Secretary of State for AI and Digital Government

Department for Science, Innovation and Technology (DSIT)

- Due to the significant expansion in AI, the number of data centres surged to 8 million in 2024 from 500,000 in 2012.
- An estimate from the International Energy Agency's Electricity Report forecasted that AI energy demand will increase tenfold between 2023 and 2026.

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What is AI? Have I used it?

- *'**Artificial Intelligence (AI)** is when **machines do tasks** that normally **need human intelligence**, like understanding language, recognising patterns, or making decisions. It's not magic. It's **maths + data + clever programming**.'*

  Dr Sam O' Neill – University of Derby

- AI has applications in healthcare, such as diagnostics, personalised medicine, and robotic surgery, and can assist with administrative and office functions by taking notes, creating summaries of documents, and performing some financial tasks.
- You have probably used AI-powered tools today on social media platforms, search engines and in MS software.

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Different Types of AI

- Generative AI – the one everyone is using (applications)
  - Art and Music Creation
  - Chatbots and Virtual Assistants
  - Drug Discovery
  - Data Privacy
  - Image Super-Resolution
- Discriminative AI – the decision making one (applications)
  - Spam Detection
  - Fraud Detection
  - Medical Diagnosis
  - Speech Recognition
  - Customer Sentiment Analysis

Generative AI vs. Discriminative AI: Understanding the Key Differences - GeeksforGeeks

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Why is AI so impactful on the environment?

- Most large-scale AI deployments are housed in data centres, which house powerful computing servers; making a 2Kg computer requires 800kg of raw materials.
- The microchips that power AI require rare earth elements, which are often extracted in environmentally harmful ways.
- Using an AI search assistant consumes around 10x the electricity of a Google search.
- AI demand and associated equipment cooling needs are projected to account for up to 6.6 billion cubic meters of water by 2027 – the equivalent of Denmark's annual water withdrawal.

Not All AI is equal (energy wise)

- AI does not have to be hosted on large servers; this is for more complex, large-scale tasks and research.
- Smaller models for specific tasks e.g. clinical note taking, can be trained and hosted on local devices(smartphones/laptops), minimising energy use.
- An Introduction to TinyML | Towards Data Science
- Bigger isn’t always better; picking the right tool(s) for the job can minimise environmental impact.

Digital Technology and Environmental Sustainability in the UK

- Nationally, the Government Digital Sustainability Alliance (GDSA) was formed in 2022, led by Defra.
- The GDSA examines the environmental benefits of digital transformation and also assesses its impacts.
- GDSA is made up of four core Working Groups:
  - **Circular Economy** – ensuring device and equipment reuse, recycling and limiting waste
  - **Scope 3 Emissions** – Improving the data and reporting on the impact of Scope 3 emissions (supply chain, transportation, product usage and disposal), which is usually the largest source of a business's emissions.
  - **Planetary Impact** – Considering the hidden impacts of technology from infrastructure (e.g. data centres), mineral and metal extraction, water and energy use and e-waste.
  - **AI Sustainability** – Understanding the impacts of AI on the environment, developing standards and guidance around sustainable AI, and exploring questions around reporting and measurement.

Government Digital Sustainability Alliance (GDSA) – UK Government Sustainable ICT

Government guidance on AI

- A multi-organisational group of stakeholders made up of central government departments, arms-length bodies, devolved administrations, public sector bodies, industry(big tech) and academic institutions have co-produced the Artificial Intelligence Playbook for the UK Government(published 10 February 2025)
- The playbook defines 10 core principles for AI use in government and public sector organisations.
  - Principle 1: You know what AI is and what its limitations are
  - Principle 2: You use AI lawfully, ethically and responsibly
  - Principle 3: You know how to use AI securely
  - Principle 4: You have meaningful human control at the right stage
  - Principle 5: You understand how to manage the AI life cycle
  - Principle 6: You use the right tool for the job
  - Principle 7: You are open and collaborative
  - Principle 8: You work with commercial colleagues from the start
  - Principle 9: You have the skills and expertise needed to implement and use AI
  - Principle 10: You use these principles alongside your organisation's policies and have the right assurance in place.

AI Playbook for the UK Government - GOV.UK

What the AI playbook says about environmental sustainability

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- Principle 2 says:

  ‘You should understand and manage the environmental impact of the AI systems you are planning to use. You should also use AI technologies only when relevant, appropriate and proportionate. Choose the most suitable and sustainable option for your organisation’s needs.’

- *Use cases to avoid:*

  ‘high-risk or high-impact applications: AI should not be used on its own in high-risk areas which could cause harm to someone’s health, safety, fundamental rights or the environment’

- *Safety, security and robustness*

  ‘Safety refers to a system’s ability to operate without causing harm to people or the environment. This is particularly important in high-risk areas such as healthcare, policing and justice.’

- *Societal wellbeing and public good*

  ‘Sustainability: AI can potentially provide a public benefit by helping meet sustainability goals. However, it can also present risks relating to energy and resource consumption derived from both the training and deployment of some AI technologies. If you plan to use generative AI tools, consider that it’s usually less environmentally sound to train your own model if appropriate pre-trained models are available. Generative AI can be expensive to operate, so it should not be used for tasks that could be undertaken by other available technologies’

- *Practical recommendations*

  ‘Assess the environmental impact of training and/or deploying your AI system before commencing development. Consider whether the impact represents a reasonable trade-off between benefits and energy consumption, and whether a less energy-intensive system might be able to achieve the same or similar results. Also consider any actions you can take to make technology sustainable.’

  ‘Evaluate the environmental credentials of potential model providers and wider partner organisations – including their use of renewable energy, energy-efficient infrastructure and sustainable practices – and select low-carbon emission energy grids.’

Further work by Defra

- Defra are working with GDSA on a draft for a sustainability section in the AI Playbook, and with Defra's sustainability centre on sustainable procurement guidance/standards for AI. These are currently in development and will be shared in due course.
- Defra have also produced internal guidance documents (available on request):
  - Defra AI Sustainability:
    - Position Statement
    - Guidance for project teams
- Working with other government departments to measure the impact of MS Co-pilot, using tools like EcoLogits Calculator

NB Co-pilot uses GPT-4.1; Microsoft does not currently share data on the impact of Co-pilot; calculations are based on GPT-4 which provides an estimate and may not be comparable. It is expected that Microsoft will share that information in future.

AI impact results from EcoLogits- impact of 1 x AI prompt

Environmental impacts

To understand how the environmental impacts are computed go to the 📖 Methodology tab.

Energy	GHG Emissions	Abiotic Resources	Primary Energy	Water
$4.39\ Wh$	$2.68\ gCO2eq$	$6.23e-09\ kgSbeq$	$44.9\ kJ$	$Upcoming...$
Evaluates the electricity consumption	*Evaluates the effect on global warming*	*Evaluates the use of metals and minerals*	*Evaluates the use of energy resources*	*Evaluates the use of water*

That's equivalent to ...

Making this request to the LLM is equivalent to the following actions :

Walking	Electric Vehicle	Streaming
$80.6\ meter$	$25.8\ meter$	$2.51\ min$
Based on energy consumption	*Based on energy consumption*	*Based on GHG emissions*

What if 1% of the planet does this request everyday for 1 year ?

If this use case is largely deployed around the world, the equivalent impacts would be the impacts of this request x 1% of 8 billion people x 365 days in a year.

31 Wind turbines (yearly)	IE 0.004 x Ireland (yearly ⚡ cons.)	442 Paris ↔ NYC
Based on energy consumption	*Based on energy consumption*	*Based on GHG emissions*

Provider: OpenAI

Model: chatgpt 4o

Example prompt: Write a Tweet (50 output tokens)

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What the NHS is doing?

- NHS Greener Digital leads are collaborating with DEFRA and GDSA to develop resources for the NHS.

  ‘One of the complexities in this space is around the 'net-impact' of AI – yes, AI is more energy/IT heavy ... but... if it unlocks larger savings, that is better than not using it at all. It’s about using it appropriately and efficiently rather than one-size-fits-all guidance.’

  NHSE Greener Digital Lead

- The NHS Greener Digital Programme is working to empower the NHS to operate low-carbon, climate-resilient digital health systems. Greener by Design: an ambitious initiative to embed climate-friendly practices across every facet of digital health will be officially launched in early 2026.

  Greener by Design - Greener Digital - Futures

  (NB – Registration Required)

Other -Computational Science

- Green algorithms project. '*The Green Algorithms project aims at promoting more environmentally sustainable computational science. It regroups calculators that researchers can use to estimate the carbon footprint of their projects, tips on how to be more environmentally friendly, training material, past talks etc.'* Green Algorithms | Green Algorithms
- All software, including AI, utilise algorithms; some have less of an impact on the environment than others, through being less energy intensive.
- The project is supported by the University of Cambridge, Welcome (a global health charity), the National Institute of Health Research and Health Data Research UK.

Fit for the future: 10 Year Health Plan for England

- The NHS 10-year plan, published in July 2025, refers to the use of AI technology throughout.
- It sets out the ambition to make the NHS ‘the most AI-enabled health system in the world with AI seamlessly integrated into clinical pathways.’
- It also reaffirms the commitment to the NHS’ environmental obligations:

  ‘All NHS bodies will be expected to decarbonise, reduce environmental impact and increase resilience to climate risks in line with the climate change duties set out in the Health and Care Act 2022.’
- Therefore, the NHS must adopt and embrace AI technology while also fulfilling its environmental commitments.

NHS 10-year Plan – 2025 – AI Applications

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Application Area	Specific AI Use Case	Anticipated Benefit/Outcome
Patient Engagement	AI-enhanced NHS App for advice, booking, self-referral	Personalised care, empowered patients, reduced reliance on traditional access points
Staff Productivity	AI scribes for administrative tasks	Reduced administrative burden for staff, freeing up time for patient care, significant cost savings
Diagnostics & Population Health	AI solutions for population health management, identifying service gaps, resource allocation	Improved population health, early disease detection, optimised resource distribution
Research & Innovation	Genomic data analysis, Health Data Research Service	Accelerated discovery of new treatments, precision medicine, predictive care, economic growth

What should NHS organisations be doing?

- Regard national guidance and embed environmental sustainability into digital strategies.
- Ensure that environmentally sustainable principles and impact assessments are applied to the procurement of AI technology and in the redesign of care pathways.
- Increase awareness of AI through briefings, supporting resources and staff training (as it becomes available).
- Identify high-impact interventions to reduce the environmental impact of AI.

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Summary

- National government guidance is available and should be utilised when rolling out AI solutions.
- AI is already utilised daily in software and devices.
- Whilst AI is more energy intensive, with the correct management and solution, it can also help us be more efficient and reach our climate targets.
- Some software/models are less resource intensive than others.
- Further guidance and information on the environmental impacts of AI and digital solutions are being developed.
- Calculating the environmental impact of AI is ongoing and not exact.
- It isn’t necessary to use AI in and should not be used for tasks that other available technologies could undertake.

Resources

Sustainability

AI Playbook for the UK Government - GOV.UK

Government Digital Sustainability Alliance (GDSA) – UK Government Sustainable ICT

EcoLogits Calculator - a Hugging Face Space by genai-impact

Green Algorithms | Green Algorithms

Greener Digital – Futures (requires registration)

General

Artificial intelligence use in NHS communications | NHS Confederation

NHS England » Artificial intelligence (AI) and machine learning

AI in practice - NHS England Digital

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Further information / news

AI has an environmental problem. Here’s what the world can do about that.

The Environmental Impact Of Artificial Intelligence – The Organization for World Peace

The Rise of 'No-LLM' AI: Building Lightweight Models with TinyML | Markaicode

Generative AI vs. Discriminative AI: Understanding the Key Differences - GeeksforGeeks

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Please send any feedback or items for inclusion to nhsgm.sustainability@nhs.net