What Powers AI? Exploring Its Environmental and Equity Impacts

Competency

Educators explain how AI systems consume energy and natural resources, demonstrate ways to reduce their environmental impact, and communicate responsible practices that support sustainability in education.

Key Method

The educator helps students and colleagues understand the environmental impact of AI technology. They guide their school community in identifying and sharing practical ways to use AI more sustainably. The educator demonstrates both conceptual understanding and practical application through three hands-on, performance-based artifacts.

Method Components

Have you considered the hidden costs of the AI tools you integrate daily? Educators regularly use AI to streamline their work by differentiating curriculum, generating rubrics, or creating instructional visuals. Every interaction consumes data and resources, contributing to a tangible environmental footprint. This micro-credential moves beyond awareness, equipping you with the knowledge to decode AI's environmental impact and model essential sustainable digital literacy for your colleagues and students.

What Is the Environmental Footprint of AI?

The rapid expansion of artificial intelligence has driven technological progress, but it also entails high environmental costs and heightens equity concerns throughout its lifecycle—from resource extraction to operation and disposal. Some areas of impact to consider are:

- **Energy Use (Electricity):** Data centers that support AI systems require vast amounts of electricity and access to stable energy grids with high-voltage power lines. The continuous energy needed to power and cool the equipment means that maintaining reliable AI operations consumes significant electricity. As more people and businesses adopt AI technologies, this energy demand will continue to rise.
- **Water Use:** AI data centers generate substantial heat as they process information, which requires water in the cooling systems necessary for the operation. The increased electrical consumption also requires additional water usage to generate it. The impact is often equity-focused, as many of these centers are in areas already water-stressed. An AI data center can require 3–5 million gallons of water per day, comparable to the water use of a city of 40,000 people.
- **Material Use (Natural Resources):** The hardware that powers AI, such as chips, servers, and graphic processing units (GPUs) is dependent on the mining of rare-earth minerals and other natural resources. This is a finite resource problem tied to the beginning of the AI lifecycle.
- **Waste (E-Waste):** Technology is ever-changing, leading to rapid obsolescence. Replacing outdated servers and components generates large amounts of electronic waste (e-waste), which often contains toxic materials that can contaminate soil and water unless properly managed.

Decoding the AI Resource Lifecycle

To effectively teach and model sustainable practice, educators must first master the concept of the AI Resource Lifecycle. This simplified breakdown shows how energy, water, and materials are consumed at each stage, highlighting areas for sustainable design and practice.

Data Collection and Storage

Data centers operate around the clock to store, process, and manage vast amounts of information. These facilities rely on continuous electricity to power servers, maintain connectivity, and ensure uninterrupted performance. This generates significant heat, requiring large volumes of cooling water to regulate temperatures and prevent equipment failure. Together, these factors make data centers the critical backbone of AI systems—but also major contributors to global energy and water consumption.

Ensuring the sustainability of AI operations while reducing environmental impact requires awareness of system function and innovation. Many of these AI centers are in rural areas, where they may compete with local communities for land and water resources. Developing data centers powered by renewable energy and equipped with energy-efficient cooling systems, such as liquid or geothermal, can mitigate environmental impact and promote responsible AI growth.

Model Training

Model training is the most energy-intensive stage in the AI lifecycle. The large-scale computation required to build and refine algorithms demands vast amounts of electricity, often causing spikes in energy use during extended training runs. This process also depends heavily on hardware made from rare-earth minerals used in CPUs and GPUs. Together, these factors contribute to significant carbon emissions and resource depletion.

To improve sustainability and lessen environmental impact, researchers and companies can focus on developing smaller, more efficient models and optimizing existing architectures. Sharing training infrastructure across institutions and using renewable energy sources for computation can further reduce energy waste and the overall carbon footprint of AI development.

Model Deployment

Models are often hosted on cloud networks to be active and accessible by users. This hosting requires constant electricity. In addition, the need for backup systems and redundant storage for data increases energy and cooling demands.

To improve sustainability and minimize emissions, data centers can use carbon-neutral cloud providers and optimize server schedules.

Everyday Use (Impacts)

The everyday use of AI contributes to ongoing environmental impacts. The accessibility and convenience of these tools encourage constant interaction, and each prompt, response, or query requires additional electricity to process. On a global scale, billions of daily AI requests translate into a substantial and growing energy demand.

Improving sustainability amid increasing usage presents a challenge. One approach is to promote mindful use of AI—encouraging users to batch queries, (where multiple processes are undertaken simultaneously to save time and resources), choose energy-efficient tools, and incorporate these habits into digital literacy and student technology instruction. Such practices can help balance the benefits of AI with a more responsible approach to its environmental footprint.

Hardware Production and Disposal

The lifecycle of AI hardware carries high environmental costs. Once these materials are processed and assembled, the distribution and operation of AI systems continue to add to the overall environmental footprint. When the hardware reaches the end of its lifespan, it becomes electronic waste (e-waste), which often contributes to the growing strain on global landfills.

Reducing the environmental impact of AI hardware requires intentional design and responsible end-of-life management. Sustainability efforts can include implementing recycling programs, extending the usable lifespan of hardware, and developing modular systems that are easier to repair or upgrade rather than replace. Educators can introduce concepts such as the circular economy and environmental justice to help students understand how technology, resource use, and equity intersect. By linking these lessons to real-world examples, learners can explore how innovation and sustainability can coexist in the future of AI development.

Each stage in the AI lifecycle offers an opportunity for responsible design and thoughtful teaching. By highlighting concepts such as renewable-powered data centers or efficient model design, educators can ensure students see the inherent connection between technology and sustainability. By mastering the environmental costs and discussing realistic solutions, we collectively empower the next generation to be responsible digital citizens.

What Is the Global and Local Impact?

The impact of AI reaches far beyond our computer screens and classrooms. While technology is often described as "cloud-based," the reality is that the cloud lives on the ground, in massive data centers that draw power, use water, and occupy physical space in real communities. Global competition impacts local communities. Other countries, such as China are increasing their use and development of AI centers in a quest to monetize AI. Competition can be healthy for an industry, but also puts additional strain on limited resources as large companies seek to increase their market share.

Many of these centers are frequently built in rural or low-resource regions where land and utilities are more affordable. This creates a critical equity challenge because the potential for short-term economic gains, such as construction jobs and tax revenue, must be weighed against the strain on shared natural resources—competition for water conflicts directly with agricultural or residential needs. The increased electricity demand leads to increased pollution and greenhouse gas in these areas. As demand increases, tech giants are seeking ways to power their systems. Microsoft has recently sought to reopen a nuclear power plant. As power needs increase, the long and short-term impacts must be considered.

Understanding the trade-offs gives educators a powerful way to connect everyday technology to the realities of environmental and social justice. Building large data centers is often coupled with tax incentives for companies that bring them in. This benefit is often borne by the current residents through increased taxes, higher water rates, and environmental impacts. Local citizens are increasingly subsidizing AI infrastructure through rising electricity bills. Specifically, in parts of Oregon, residents have paid as much as 2.5 times more for their electricity than the data centers in the area. Over 36 states offer sales and property tax exemptions to data centers, which can reduce local tax revenues. As educators, we can guide our learners to explore who benefits economically from the growing AI industry and who bears the environmental cost when water tables drop, or air temperatures rise near data hubs. Many of these impacts are also affecting local ecosystems. As these centers are built in indigenous and agricultural areas, it is vital that those impacted locally have a voice in the process of bringing data centers to their community. By examining these questions through classroom inquiry or discussion, we help students see that innovation often comes with uneven impacts and that informed citizens can push for fairer, more sustainable solutions. When schools, districts, and communities make decisions about infrastructure, educators' voices need to be part of the conversation. Educators can demonstrate advocacy and civic engagement and model responsible technology use.

How Can AI Be Part of the Solution?

While educators need to acknowledge AI's environmental costs, it is equally important to model optimism for innovation by highlighting how the technology can be part of the solution. AI has the potential to support sustainability by improving how we monitor, manage, and design systems for the planet's long-term health. The same tools contributing to energy demand can also help reduce waste, optimize resources, and inform better environmental decisions.

Climate and Environmental Monitoring

AI can analyze massive amounts of data to detect patterns and predict changes faster than ever before. AI-powered tools can help scientists track deforestation, monitor air and water quality, and forecast weather events. In classrooms, these examples bring science and technology together, connecting data literacy, environmental awareness, and social responsibility.

Energy Optimization

AI helps reduce waste in energy production and distribution. Smart grids use predictive algorithms to balance electricity supply and demand, helping prevent blackouts and conserve energy. Transportation systems use AI to improve fuel efficiency and reduce emissions. Exploring these applications with students illustrates how computation and creativity can directly support environmental problem-solving.

Sustainable Innovation

Developers are designing smaller, more efficient models that produce fewer emissions. Technology companies are investing in renewable-powered data centers and releasing sustainability reports that hold them accountable to measurable carbon-reduction goals. Sharing these examples shows students that ethics, accountability, and innovation can coexist.

Efficiency and Renewable Power

Many of the world's leading developers are experimenting with technologies that make AI systems cleaner and more efficient. Examples include geothermal and liquid-cooling systems that reduce water use, renewable microgrids that supply clean electricity to data centers, and low-power chip architectures that extend hardware lifespan. Highlighting these innovations helps students understand that sustainability is a design principle.

Transparency and Accountability

Governments and companies are increasingly publishing sustainability data, setting carbon-reduction goals, and reporting on their progress. These efforts create opportunities for educators to bring authentic data into the classroom, helping students analyze real-world examples of responsible AI design and compare corporate commitments to measurable outcomes. When students learn to interpret and question this data, they develop both critical thinking and civic awareness.

As educators, we must highlight these "AI for Good" examples to balance awareness of environmental impact with optimism for innovation. Encouraging students to research, design, or debate sustainable technology solutions turns a complex topic into one centered on possibility, leadership, and shared responsibility for the future.

Supporting Rationale and Research

Bender, E. M., & Koller, A. (2019). *Climbing towards NLU: On meaning, form, and understanding in the age of data*. In *Proceedings of the 57th Annual Meeting of the Association for Computational Linguistics* (pp. 5185–5198). Association for Computational Linguistics. https://doi.org/10.18653/v1/P19-1355

Crawford, K., & Joler, V. (2018). *Anatomy of an AI system: The Amazon Echo as an anatomical map of human labor, data, and planetary resources*. AI Now Institute. https://anatomyof.ai

Fiske, A. (2025). *Climate change and health: The next challenge of ethical AI. The Lancet Digital Health*, 7, Article p-S2214109X2500124X. https://www.sciencedirect.com/science/article/pii/S2214109X2500124X

Ibrahim Alnafrah. "The Two Tales of AI: A Global Assessment of the Environmental Impacts of Artificial Intelligence from a Multidimensional Policy Perspective." Journal of Environmental Management, vol. 392, 7 Aug. 2025 https://www.sciencedirect.com/science/article/abs/pii/S0301479725027896

Luccioni, Sasha, et al. "Power Hungry Processing: Watts Driving the Cost of AI Deployment?" The 2024 ACM Conference on Fairness, Accountability and

Transparency, 3 June 2024, pp. 85–99, https://arxiv.org/abs/2311.16863, 10.1145/3630106.3658542.

UNESCO. (2023). *Guidance for generative AI in education and research*. UNESCO. https://unesdoc.unesco.org/ark:/48223/pf0000386693

UNESCO. (2024). *AI Competency Framework for Teachers*. https://unesdoc.unesco.org/ark:/48223/pf0000391104

Resources

AI Support for Educators

Microsoft Elevate for Educators

AI Glossary of Terms

Glossary

AI for Good

AI For Good Lab - Microsoft Research

Google AI - Societal impact of AI and how it's helped communities

GreenAI

Microsoft Local – Community Impact and Sustainability

New Jersey Governor Signs Bill to Study Data Center Impacts

Project Guacamaya uses satellites & AI to battle deforestation

The Role of Artificial Intelligence in Environmental Sustainability | EnvironmentalScience.org

How Long Do AI Servers Actually Last?

Rural and Socio-economic Impacts

AI's Climate Impacts May Hit Marginalized People Hardest | Scientific American

AI's impact on income inequality in the US | Brookings

Data Center Boom Risks Health of Already Vulnerable Communities | TechPolicy.Press

Here's What Happens When Big Data Takes Over a Small Town | Sierra Club

Revealed: Big tech's new datacentres will take water from the world's driest areas | Water | The Guardian

Rising Water Demand from Data Centres: Addressing AI's Water Impact Through Innovation

Three Mile Island nuclear power plant will reopen for Microsoft: NPR

Teaching Resources

AI Guidance for Schools Toolkit

Empowering Educators in the Age of AI | NEA

ISTE Hands-On AI Project for K–12

Human-Centered AI Guidance for K–12 Public Schools

Teaching the Environmental Impact of AI Through PBL | Edutopia

Unlock generative AI safely and responsibly—classroom toolkit

Understanding the Basics

2025 AI in Education: A Microsoft Special Report

Artificial Intelligence in Education | NEA

AI and the Environment from Better Plant

Climate Change AI

Explained: Generative AI's environmental impact | MIT News | Massachusetts Institute of Technology

Frequently asked questions about our datacenters - Microsoft Local

NEA Policy on the Environmental Impact of AI

We did the math on AI's energy footprint. Here's the story you haven't heard

Teaching About Climate Change

Submission Guidelines and Evaluation Criteria

To earn this micro-credential, you must receive a passing score in Parts 1 and 3 and be proficient in all components in Part 2.

Part 1. Overview Questions (Provides Context)

200–350 words.
Do not include any information that will make you or your students identifiable to the reviewers.

Answer the following questions:

1. Describe your current role in education, including the grade level and subject you teach, and how AI is used in your classroom, school, or district. Include demographics of your school, community, and special considerations related to AI (such as access, prior student experience with AI tools).
2. Why do you think it is important for educators and students to understand the environmental impact of AI systems? Give one concrete example.
3. What professional growth goals or student outcomes do you hope to achieve? Provide at least one concrete example of how you hope this will impact your teaching or colleagues.

Passing:
A passing response clearly describes the educator's goal, purpose, and motivation for pursuing this micro-credential. It includes specific details about the classroom setting, relevant AI considerations, and the educator's professional goals for taking this microcredential.

Part 2. Work Examples/Artifacts/Evidence

To earn this micro-credential, please submit the following three artifacts as evidence of your learning. See the Rubric for the passing score.

*Please do not include any information that will make you or your students identifiable to your reviewers.

Artifact 1: Classroom Visual of AI's Life Cycle
Create a classroom-ready visual or infographic that illustrates the AI system lifecycle from **data collection and model training** through **deployment**, **inference**, and **hardware end-of-life.** Include two opportunities for AI for Good.

Label key stages where energy or natural resources are consumed (such as electricity, cooling water, rare earth minerals, e-waste).

Include a short commentary (150–250 words) explaining:

- Intended audience for the infographic and the purpose or setting of sharing
- Impact on sustainability at each step
- How energy use accumulates across the lifecycle, and
- How you could use this visual to support student learning.

Accepted formats: poster, digital infographic, slide deck, or annotated diagram.

Artifact 2: Action Visual

Design an **advocacy visual** aimed at educators, administrators, or school leaders. Your product may take the form of an infographic, one-page handout, or professional slide deck.

Your visual should:

- Synthesize key research on AI's energy and resource demands,
- Highlight sustainability challenges and trade-offs (such as energy use vs. accessibility, water impact of data centers),
- Acknowledge rural and socio-economic impacts, primarily where data centers are located, and
- Present at least one actionable recommendation for school- or district-level sustainability efforts.

Include a brief audience statement (100–200 words) describing who this is for, where or how you shared (or plan to share) it, and what message you want to convey.

Submit the visual and the audience statement and upload it for the reviewer.

Artifact 3: Applying and Sharing

Purpose: Demonstrate classroom or professional application of your learning about AI and sustainability.

Choose one of the following paths:

Option A – Classroom Application

- Create a co-designed lesson with a colleague that crosses at least two subject areas. Implement the short lesson or project (cross-curricular, if possible) exploring AI’s environmental impact and potential “AI for Good” innovations.

- Submit your lesson plan (or project overview), one anonymized student work sample, and a brief reflection (200–300 words) describing what students learned and how you might extend the activity.

Option B – Professional Sharing

- Facilitate a professional learning session, workshop, or meeting that helps colleagues consider sustainability when adopting or using AI tools.
- Submit your presentation materials, a summary of participant feedback, and a brief reflection (200–300 words) describing key insights and next steps for advocacy or implementation.

Part 2. Rubric

	Proficient	Basic	Developing
Artifact 1: Classroom Visual of AI's Life Cycle	The visual successfully maps and accurately labels the AI cycle, with at least five stages. Clearly identifies two "AI for Good" leverage points and includes a key message. Each stage identifies specific energy or resource use (such as, electricity, water, and rare-earth materials). At least two AI for Good Opportunities are listed. The commentary explains why these stages matter for sustainability, how energy use accumulates, and how the visual will support classroom learning. The design is clear, age-appropriate, and engaging for students.	The visual includes most key stages but may omit or mislabel one or two. Only one AI for Good is listed. Commentary touches on sustainability but lacks depth or clarity about classroom application. Visual design is understandable but may be cluttered, incomplete, or inconsistently labeled.	The visual includes fewer than three lifecycle stages or inaccuracies. No AI for Good is listed. Commentary is missing, unclear, or not connected to sustainability or instruction. Design or labeling makes the content difficult to interpret.
Artifact 2: Advocacy Visual	Visual synthesizes credible research on AI's energy and	Visual references sustainability or socio-economic impacts, but lacks depth, balance, or	Visual is incomplete, inaccurate, or missing evidence of research. Socio-economic

	resource demands, includes a clear discussion of sustainability challenges or trade-offs, and highlights rural or socio-economic impacts where relevant. It presents at least one actionable recommendation for educators or leaders. The product is polished, accurate, and appropriately designed for an adult professional audience. The audience statement clearly identifies the target group, the purpose, and how the visual will be shared.	accuracy. Research sources are minimal or unclear. Audience statement is present but vague about intent or dissemination.	context or actionable recommendations are absent. Audience statement missing or irrelevant. Product not suitable for professional use.

Artifact 3: Applying and Sharing	Submission demonstrates meaningful application of learning through either a classroom project/lesson (Option A) or a professional sharing activity (Option B). Lesson or session materials explicitly connect AI infrastructure and sustainability concepts to teaching or leadership practice. Evidence (student sample or participant feedback) supports the impact, and the reflection describes key insights, next steps, and future improvements. Work products are professional, organized, and relevant to the intended audience.	The lesson, project, or presentation shows a partial connection to AI sustainability. Evidence is limited or not clearly linked to goals. Reflection is brief or general. Materials are usable but may lack coherence or follow-through.	Lesson or presentation is unrelated to AI sustainability, or key materials are missing. No clear evidence of application or reflection. Submission is incomplete or difficult to follow.

Part 3 Reflection

(150–300words) For tips on writing a good reflection, review the following resource: How Do I Write a Good Personal Reflection? *Please do not include any information that will make you identifiable to your reviewers.* Answer the following questions: 1. What new understanding did you gain about how AI systems consume natural resources such as energy, water, or materials? Provide specific examples. 2. What sustainable or “AI for Good” practices or innovations stood out to you, and how might they influence your professional choices or advocacy? 3. How will your learning from this micro-credential inform your future decisions about teaching, technology integration, or professional collaboration? **Passing:** Reflection clearly addresses all questions with an understanding of how AI systems relate to environmental sustainability and includes specific examples or insights from the artifacts. Identifies at least one actionable step for future teaching or advocacy.