

Sustainability is a learning outcome

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Manifesto for Generative AI in Higher Education - The Book Project

Manifesto

for

Generative AI
in Higher Education
The Book Project

A community response to the Manifesto
with contributions from over 40 authors

Edited by **Hazel Farrell** & **Ken McCarthy**





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STATEMENT 24

Sustainability is a learning outcome.

SUE BECKINGHAM AND PETER HARTLEY

IMAGINATION, HUMANITY, AND THE FUTURE

*Estimated reading time: 6 minutes*STATEMENT
24**SUSTAINABILITY IS A LEARNING
OUTCOME.**

GenAI engagement and innovation comes with environmental costs. Embedding sustainability as a core learning outcome means cultivating awareness of impact and environmental responsibility.

The Hidden Cost of GenAI: Cultivating Ecological Awareness in Learning**Sue Beckingham**

Sheffield Hallam University

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This statement challenges all of us across Higher Education. If sustainability is a learning outcome, students don't just need to learn how to use GenAI; they need to learn to identify and evaluate its ecological costs. This fosters critical digital literacy.

Universities increasingly commit to the UN Sustainable Development Goals (United Nations, 2015), so we have an ideal starting point. Our focus here is environmental impact, highlighting SDGs '12. Responsible Consumption' and '13. Production and Climate Action'.

There have been specific initiatives, e.g. "100 papers to accelerate the implementation of the UN Sustainable Development Goals" (HAW Hamburg, 2024). Researchers have identified gaps in implementation of SDGs and recommended policy (Panda and Dash, 2025). Unfortunately, overall progress is "still not fast

enough to fully reach the SDGs by 2030” (WEF, 2026) – we need to accelerate progress in whatever ways we can.

Positioning sustainability as a learning outcome enables GenAI integration to align with institutional values. We can equip learners to make informed decisions about technology use in their careers. Raising awareness can encourage ‘micro-actions’ and these small steps can collectively reduce harm, while still enabling innovation, and perhaps even more importantly, encouraging self-awareness in users/students/staff. Although some challenges involve factors beyond our immediate control, we can still take actions that make a difference, through personal interventions or indirectly by influencing others.

We need to develop our response to these questions:

- What do we mean by sustainability?
- What main environmental costs are associated with GenAI use?
- How are these costs likely to change in future?
- What can we do to manage or control these costs?

The meaning of sustainability?

There is growing concern about the “significant environmental impact of information and communication technology, which accounts for 2.1%–3.9% of global greenhouse gas emissions” (Lee et al, 2025) Unfortunately these authors conclude – “current trends are unsustainable as artificial intelligence transforms the way we live and work and, consequently, as the demand for computing accelerates.” (op cit, 2025)

Main environmental costs?

One useful starting point is to define essential components and typical environmental costs of GenAI systems (See Beckingham and Hartley, 2025a and 2025b for other costs). This may not be as straightforward as it seems – researchers comment that companies may not reveal necessary details (Luccioni, 2025). Assuming some data, we can decide whether costs seem sensible/reasonable. We can also try to identify less obvious costs which may be significant longer term.

For an industry breakdown, we borrow the 5-layer model from Jenson Huang, CEO of the chip producer NVIDIA, described in several recent keynotes/interviews (WEF, 2026). He argued that the USA must increase investment in every one of these layers to achieve the overall goal of ‘AGI’ – Artificial General Intelligence – where technology can perform better than humans across a very wide range of tasks. The race to achieve AGI is on, with USA and China as leading competitors.

Table 1 lists the five layers, identifies important costs, and raises questions of environmental impact for each layer. All these questions offer opportunities for staff and student research.

Table 1: Multiple layers of Generative AI costs and environmental impact

Layer	Includes	Typical issues/costs	Questions of environmental impact include:
Applications	Specific apps we use	How good are apps in terms of longstanding problems like hallucinations and bias?	Which apps are the least damaging/ impactful for particular uses?
Models	LLMs (Large Language Models), expensive to develop and maintain	New types of models have appeared (e.g., Small Language Models, Open Source or Open Weight). Which work best. What are comparative costs?	Do users consider environmental impact when they decide which GenAI to use?
Infrastructure	Datacentres, housing the computers running AI	Datacentres take years to build – how long before they recoup investment?	What is the long-term impact of these structures on local/regional communities?
Chips	The silicon chips used in the computers	These are very powerful and costly. What is their shelf life?	Chips may contain significant quantities of rare substances with environmental concerns. Are there alternatives?
Energy	As well as obvious demand for electricity, computers need constant cooling	Can the local/regional energy infrastructure cope with increased demand?	Datacentres often locate in areas not prepared for increasing energy stress. How will this be managed?

We cannot estimate the total costs (and impact) of GenAI/AI development unless we include all these layers.

Plans for new datacentres are increasingly scrutinized for environment implications. For example, AI's water usage for datacentre cooling, electricity generation and semiconductor manufacturing will likely expand 8.5 times by 2028 (Fu, 2026:12). Whilst writing this chapter, plans for a 'green datacentre' in Edinburgh (Scotland) were rejected on several grounds, including environmental impact through emissions, use of diesel generators as backup power, and excessive water and energy use (Williamson, 2026).

We can translate examples like this into exercises and discussions with students using reports and official documents in the public domain. For example, in interdisciplinary groups, students can pursue the case study from their own disciplinary perspective, with sustainability as the overall learning outcome.

Managing and controlling costs?

Whilst it is important to consider and discuss the environmental costs of using GenAI, ongoing research is needed to provide solutions (Luccioni et al, 2024a; Luccioni et al, 2024b), continued challenging of the 'greenwashing' by tech companies (Joshi, 2026), and interrogating claims that 'all AI' provides climate benefits (Taft, 2026).

In the meantime, we propose ten micro-actions – small steps for individuals to have a scaled impact. Please use Figure 1 and the expanded version (Beckingham and Hartley, 2026) with students and discuss their reactions:

- Ask: *Do I really need GenAI for this task?*
- Choose the lowest impact tool first.
- Prompt with precision.
- Keep outputs short.
- Avoid energy intensive tasks when possible.
- Reuse instead of regenerate.
- Reduce background computation.
- Share and scale smartly.
- Use existing media instead of generating new.
- Optimise your device use.

10 Micro Actions to Reduce the Environmental Impact of Generative AI

Small steps - Scaled Impact



Green micro actions are small, achievable steps that individuals and organisations can take to reduce the environmental impact of Generative AI (GenAI).

GenAI tools are powered by large language models that process vast amounts of data in energy-intensive data centres. Each query and GenAI interaction requires computation and cooling, which consumes electricity and contributes to carbon emissions and environmental impact.

1



Ask: Do I Really Need GenAI For This Task?

Use GenAI for complex, high-value tasks — not out of habit.

- Does this task require generation or just retrieval?
- What is the real value GenAI adds here?
- Could I do this myself in the same amount of time?

Reserve GenAI for tasks requiring synthesis, analysis, or creativity

Choose the Lowest-Impact Tool First

Before opening a GenAI tool, consider other options.

- Use a traditional search engine for simple facts
- Check your notes or saved documents
- Use built-in tools (spellcheck, summariser in Word)
- Refer to offline resources (books, glossaries, handouts)
- Draft short emails yourself



2

3



Prompt with Precision

A well-crafted prompt reduces unnecessary generations.

- Be specific about format and length
- Combine multiple questions into one request
- Include examples and constraints
- Avoid repeated "try again" back-and-forth

Keep Outputs Short

Long responses require more computation

- Request a 3-sentence summary
- Ask for bullet points
- Specify "keep it concise"
- Limit word count where possible



4

Avoid Energy-Intensive Tasks When Possible

Figure 1: 10 Micro-actions to reduce the environmental impact of GenAI

Final reflections

As suggested, we can take actions that make a difference.

We all have environmental responsibility, so we must ensure that our students and colleagues are aware of the enormous scale and significance of the GenAI/AI industry as it now expands into every area of our lives. By providing opportunities in the curriculum to investigate issues and questions that arise, challenging tech companies to “pull back the curtains”, which hide some of the key data and trends, and ensuring sustainability becomes a key learning outcome, we can make positive steps towards critical GenAI literacy.

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CONTINUE THE CONVERSATION

How does this statement connect with your own experience of teaching, learning, or higher education?

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SCAN TO RESPOND

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