

Sustainability of Generative AI

1. Introduction

While Artificial intelligence (AI) has incredible potential to help us resolve economic, societal and environmental issues, AI tools consume natural resources and leave a significant carbon footprint.

Definitions for terms used in this activity:

In this activity we refer to Large Language Models (LLMs), which are a type of artificial intelligence (AI) program designed to understand and generate human language.

In AI, a prompt is the input or instruction given to a model to generate a specific response.

A query, on the other hand, is a request for information or an instruction to a database or AI system to find relevant information.

You can learn more about Generative AI in our [**Generative AI pathway**](#).

Using this activity

Use the back and next buttons at the bottom right of the screen to navigate through the tutorial. Alternatively, use the contents button to jump to a specific page.

You will need to allow approximately **15 minutes** to complete the activity.

Learning outcomes

In this activity you will consider the carbon footprint of using AI in education.

You will learn about:

- the environmental impact of creating and running generative AI tools globally;
- the carbon footprint impact of individual prompts;
- and how to make your use of AI tools more sustainable.

2. The environmental impact of AI tools Part 1

The environmental impact of AI tools in two phases

The environmental impact of AI tools occurs during two distinct phases:

Creation and training phase

The creation and training of generative AI tools such as ChatGPT, Gemini or Copilot, requires extensive data analysis, which consumes vast amounts of electricity and generates heat. It is estimated that the creation of ChatGPT used 1,287 megawatt hours of electricity and produced 552 tons of CO₂, which equates to driving 123 petrol powered cars for a year.

Operations/inference phase

Data centres are essential for powering AI. In 2024 they accounted for about 1.5% of global electricity use. This is projected to more than quadruple by 2030. To cool these data centres, huge quantities of water are required – about 500ml for every 20-50 AI prompts.

3. The environmental impact of AI tools Part 2

The environmental impact of generative AI tools falls in two distinct categories:

1. the energy used to run the tools;
2. the emissions, i.e. the carbon footprint, these tools produce.

1. Energy use of individual AI outputs

It is difficult to estimate the energy use of standard queries using prompts, because the outputs can vary from a few sentences to many pages.

When comparing electricity demand, a single Google search takes 0.3 watt-hours of electricity, while ChatGPT takes 2.9 watt-hours of electricity for a single prompt. That's nearly 10 times as much electricity needed.

Creating text 1,000 times (each individual response within a conversation is considered as one instance of text) uses as much energy as 9% of a full smartphone charge.

2. Carbon footprint of individual AI outputs

Because of the different sizes of the various available LLMs and the different systems they use, it is difficult to calculate exact emissions, but considering training and output together, it was calculated in 2024 that the combined impact of training and operation for ChatGPT amounts to approximately 2.2g CO₂e per query.

The following numbers help illustrate the environmental impact of using AI:

Standard queries using prompts

25 simple ChatGPT queries equate to the CO₂ emissions of watching one hour of video streaming (55g CO₂e).

110 queries are roughly equivalent to the emissions from one load of laundry washed and dried on a clothesline.

Generating images

Generating images is by far the most energy- and carbon-intensive AI-based task. Creating an image using a powerful AI model takes as much energy as charging your smartphone to 50%, for example.

The most carbon-intensive image generation model generates the same amount of carbon it takes to drive 4.1 miles in an average petrol-powered car for 1,000 inferences (a prediction or response to a query).

4. Activity: Which do you think has a higher impact on the environment?

Choose one answer from the options provided.

Question 1 of 3

Which has a higher impact, 10 mins in a car or running 250 GenAI queries?

Option 1: 10 mins in a car

Option 2: 250 GenAI queries

Question 1 Feedback for Option 1

That is correct, 10 mins in a car produces c. 560g CO₂, while 250 GenAI queries produce c. 550g CO₂.

Question 1 Feedback for Option 2

That is incorrect, 250 GenAI queries produce c. 550g CO₂, while 10 mins in a car produces c. 560g.

Question 2 of 3

Which has a higher impact, 10 mins hot shower or running 1000 GenAI queries?

Option 1: 10 mins hot shower

Option 2: 1000 GenAI queries

Question 2 Feedback for Option 1

That is incorrect, a hot shower produces c. 2000g CO₂, while 1000 GenAI queries produces c. 2200g CO₂.

Question 2 Feedback for Option 2

That is correct, 1000 GenAI queries produces c. 2200g CO₂, while a hot shower produces c. 2000g CO₂.

Question 3 of 3

Which has a higher impact, using one plastic water bottle or running 35 GenAI queries?

Option 1: Using one plastic water bottle

Option 2: 35 GenAI queries

Question 3 Feedback for Option 1

That is correct, using a plastic water bottle produces c. 83g CO₂, while 35 GenAI queries produce c. 77g CO₂.

Question 3 Feedback for Option 2

That is incorrect, 35 GenAI queries produce c. 77g, while using one plastic water bottle produces c. 83g CO₂.

5. A critical approach to using GenAI tools sustainably

As you will have learnt, while this is a complex thing to calculate, generative AI tools clearly pose significant challenges when it comes to reducing CO₂ emissions. While using these tools may not generate a huge number of emissions, the training of the LLMs has a significant impact on the environment. However, even here there are considerable differences between the different tools, depending on the technology they use to train the LLMs and manage the data centres.

How can you use AI sustainably? Reflection activity

Now that you have learned a bit more about the environmental impact of using AI tools, what can you do to use it more sustainably?

Use the space below to write three things you can do.

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6. Summary

In this activity you have learned about:

- 1 the environmental impact of creating and running Large Language Models (LLMs);
- 2 the carbon footprint of individual prompts;
- 3 and have considered how to make your use of AI tools more sustainable.

For further activities on Generative AI or Sustainability, you may find the following useful:

- **Being Digital** is an online collection of short easy-to-follow activities. The activities can help you to learn more about Generative AI, sustainability of digital literacy information skills, as well as many other aspects of digital study.
- **Greener online study**
- **Coping with Climate Anxiety**
- **An introduction to Generative AI**
- **Responsible and ethical use of Generative AI**
- **Using effective prompts in generative AI**
- **Generative AI and critical thinking**
- **Generative AI and plagiarism**