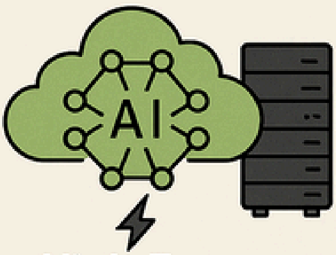
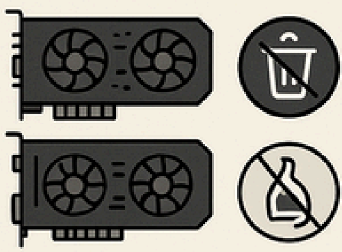
Environmental Impacts of the Use of AI Models



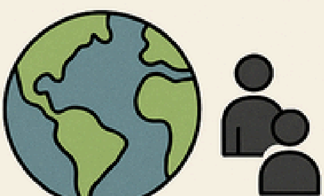
High Energy Consumption

Carbon Emissions

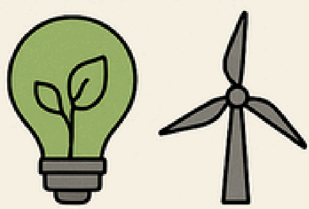
Data Center Resource Use



Hardware Lifecycle and E-Waste



Unequal Environmental Burden



Mitigation Strategies

Environmental Impacts of the Use of AI Models

AI models, particularly large-scale systems, have a considerable impact on the environment due to their substantial energy consumption and carbon emissions.

Training models like GPT and BERT demands significant computational power, which contributes to greenhouse gas emissions and places a heavy burden on data center resources, including electricity, water, and raw materials. Moreover, the need for frequent hardware upgrades results in increased electronic waste. The adverse effects of these practices are not evenly spread, often disproportionately affecting regions with weaker environmental regulations.

To address these challenges, efforts are being made to implement sustainable practices, such as optimizing model design, utilizing renewable energy, and advancing green AI initiatives to lessen the ecological footprint of artificial intelligence.

Energy Consumption

How AI uses Energy

Training Large Models

- Training a large AI model can consume hundred of mega-watt hours (MWH)
- CHAT GPT-3 reportedly consumed around 1,287 MWH during training, or the annual energy use of 100 U.S. homes.

Inferences

- Once in use, model require massive ongoing computational power to operate
- AI-powered applications run millions of inferences daily

Technology

- AI drives the growing demand for specialized hardware, which are energy intensive

Energy Demand

- AI is contributing the growth in data center electricity use, even projected to double between 2022 and 2026.

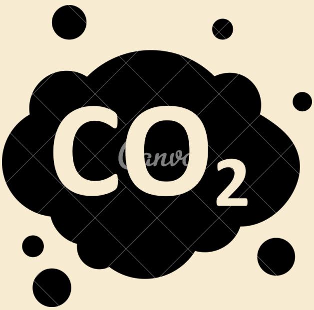
*How to **Mitigate** These Functions*

- Using energy-efficient model structures and hardware
- Implement carbon-aware computing, where jobs are schedule when and where renewable energy is available

Carbon Emissions

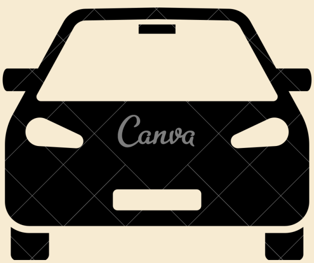
How does AI contribute to Carbon Emissions?

AI usage relies on 24/7 Data Centers that account for somewhere in the ballpark of 3% of all of the world's Carbon Emissions.



Expert estimates put the impact of AI model usage on data center carbon emissions as potentially 5x as much as a standard Google search would produce.

Training the model also consumes an incredible amount of energy. For example, training GPT-3 output an equivalent amount of Carbon as driving 112 cars for a year.



Water Usage

Water use primarily comes from cooling data centers:
Data centers often rely on water-based cooling systems to maintain optimal temperatures for servers running AI workloads.
Water is either evaporated in cooling towers (consumptive use) or circulated and discharged (non-consumptive, though still resource-intensive).

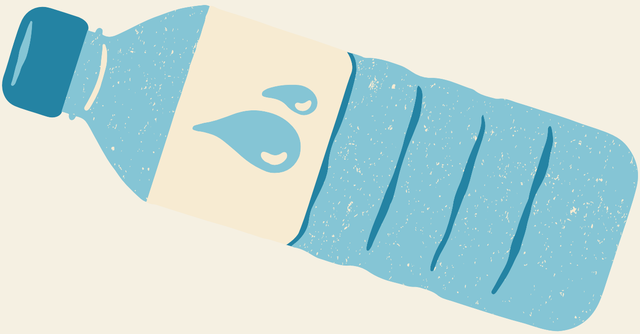
How Much Water Are We Talking About?

Estimates vary, but here are some notable examples:

Training GPT-3 is estimated to have consumed ~700,000 liters (185,000 gallons) of freshwater, mostly for cooling.

For comparison, that’s equivalent to the amount of water needed to produce 370 Tesla electric cars or roughly 300 U.S. households' daily use.

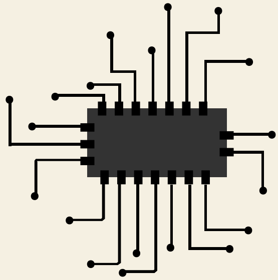
A 2023 study estimated that ChatGPT consumes ~500 mL of water for every 5–10 prompts—equivalent to a small bottle of water.



Electronic Waste

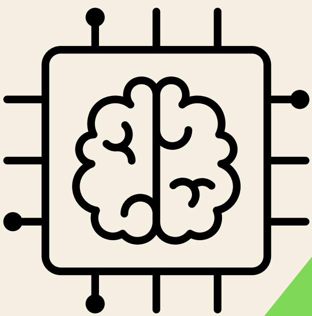
AI could produce 3 MILLION tons of E-Waste by 2030.

Electronic waste, or E-Waste, is a significant aspect of understanding how AI can have a negative environmental impact.

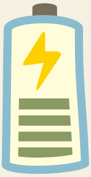


E-Waste is the waste of electronic components or computer parts that are difficult to break down and often contain hazardous materials.

As AI becomes increasingly powerful and have a higher demand for energy and processing power, the need for AI companies to constantly upgrade/replace hardware and contribute significant amounts of E-Waste will grow.

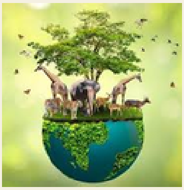


Environmental Benefits



Energy Efficiency – AI optimizes power grids, predicts energy demand, and enhances renewable energy integration, reducing waste and improving efficiency.

Wildlife Conservation - AI-powered drones and image recognition help monitor endangered species, detect poaching activities, and support habitat restoration.



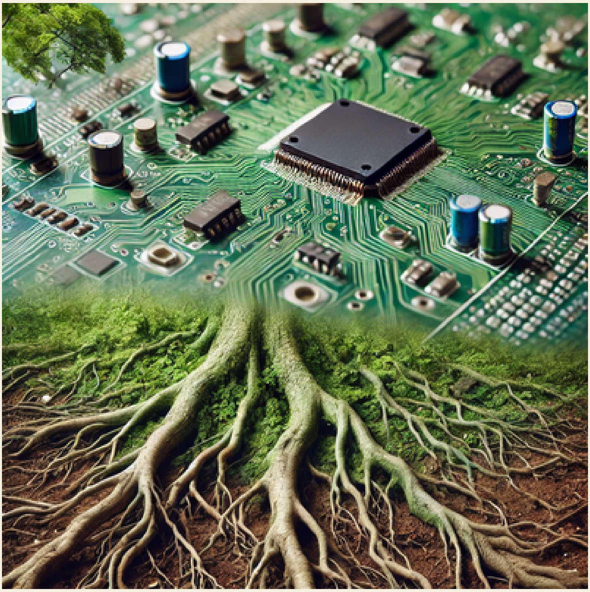
Smart Cities - AI improves urban planning, optimizes traffic flow, and enhances air quality monitoring, making cities more sustainable

Sustainable Agriculture – AI-driven precision farming optimizes irrigation, monitors soil health, and reduces pesticide use, promoting eco-friendly food production.

Climate Modeling – AI improves climate predictions, helping scientists analyze weather patterns, track emissions, and develop strategies for climate resilience.

Waste Management – AI enhances recycling processes by identifying materials, automating sorting, and reducing landfill waste.

The role of AI in the environment is both a challenge and a solution.



The duality requires a delicate balance!

Maryam Muhammad Bashir
Abigail Boafo
Kaleb Bryan
Sam George

Group Reflection

As a group we elected to focus on AI's impact on the environment due to our engagement with AI this semester within the course. Our intended audience is individuals who are interested in learning more about AI, its impacts, and how to navigate those impacts. These individuals are not required to have a certain level of education or knowledge of AI, with our zine including an overview of AI and a breakdown of its varying impacts (Energy consumption, Carbon Emissions, Water Usage, and its environmental benefits). The effect of this is keeping the potential for our zine to have an impact on any given person to stumble across it is high. Avoiding getting too technical or too niche in our focus keeps the zine accessible to a broader audience and means your average consumer could understand what we are discussing here. Anyone should be able to recognize the significance of what is being discussed without feeling like they need to visit an encyclopedia or dictionary to understand it.

We approached the collaborative design process in a two pronged manner. Digital communications and in-person communication as well as digital document construction through Canva. This approach was established due to conflicting schedules and time of the year in which each of us as individuals are under time constraints and engaged with graduate course work as well as instruction. We each assigned ourselves section responsibilities and worked independently building upon each other's work in terms of styles and color designs. Some group members handled document-wide decisions such as colour palette and design features, but each individual page was mostly done by the individual responsible for each page. This asynchronous style of work allowed us to fit this assignment into a pretty hectic time of the semester for us students, and not feel as much stress surrounding the work being done.

We each completed our sections and took responsibility for editing each other's section and the zine as a whole. This collaborative process allowed us to appreciate each other's work pace and process. Despite the juggling coursework, tight schedules, and different working styles we found that using Canva and Google Docs made the process quite seamless. Overall, this zine making process has been eye-opening and interesting.