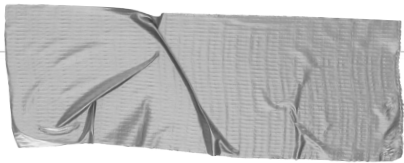

Environmental Impact of the AI Supply Chain

By Ahmed Elghareeb
Center For Digital Trust
EPFL

**How bad is it to
“Operate AI”?**



Inference carbon emissions

Every 2 images require the same electricity as a modern smartphone takes for a full charge

On the estimate of 13 million daily users, each doing 15 queries.
Emissions would be 10K tons CO₂eq/ month.

GPT4 causes 10 to 100 times more emissions than GPT3

1 Each query 4.32g of CO₂

Using a CO₂ calculator and some basic math, ChatGPT produces more CO₂ per query than Google (apparently, each search query in Google results in 0.2g CO₂ per query.)

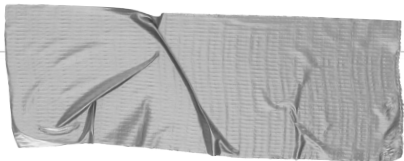


5 30,000 GPUs to keep it running

Reports earlier this year indicated OpenAI uses over 30,000 Nvidia A100 GPUs to keep the generative AI tool running.



**How bad is it to
“Train AI”?**



Training Emissions

Training emissions of LLAMA models went up from 600 to 2290 tons of CO₂e in the years 2023, and 2024.

Google's greenhouse gas emissions in 2023 were 48% higher than in 2019, according to its latest environmental report.

CARBON COST OF TRAINING AI

Training is the final compute-intensive stage in AI model development, where large datasets are used to iteratively adjust a model's parameters to enable it to recognize patterns and perform tasks.

Researchers estimate it took OpenAI around 34 days to train GPT-3.

1

One passenger flight from New York to San Francisco

63

Average car lifetime emissions (including fuel)

GPT-3 (175B)

502

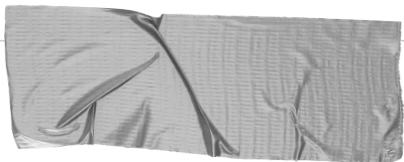
Llama 3 (70B)

1,900

Metric tons of CO₂ equivalent



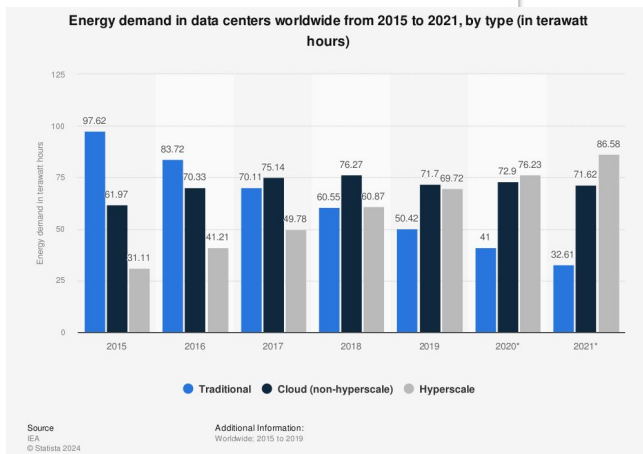
**How bad is it to
“Operate a Data Center for AI” ?**



Data Centers

Microsoft & OpenAI consider \$100bn
5GW (~43 TWh/ year) 'Stargate' AI data center

Total Energy
consumption in
2021 was 190
TWh. 1~2 % of
global
Electricity.



independent.co.uk/tech/solar-panel-farm-worlds-biggest-china-b2556888.html

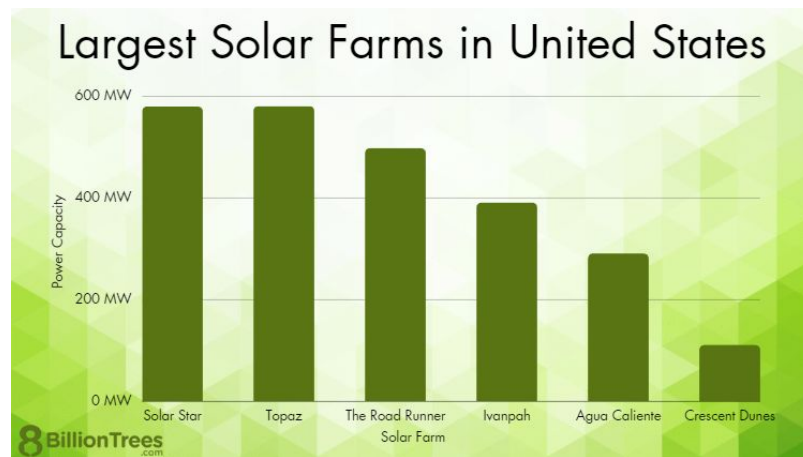
INDEPENDENT

SPORT VOICES CULTURE **LIFESTYLE** TRAVEL PREMIUM MORE

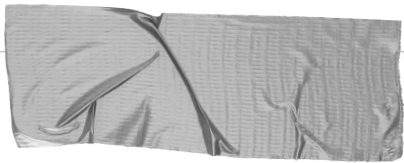
Tech

World's biggest solar farm goes online, big enough to power a country

5GW facility is roughly the same area as New York City



How thirsty is AI?

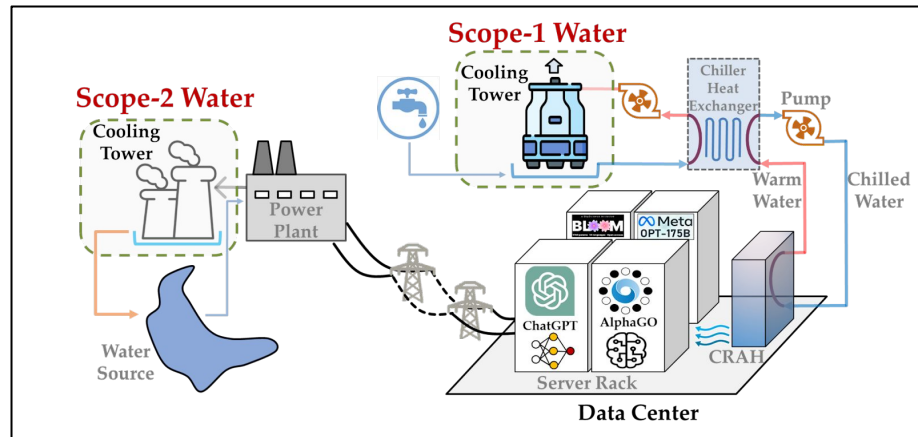


Data Centers - Water footprint

To produce a microchip takes > 8000 liters of Ultra-Pure Water (UPW)

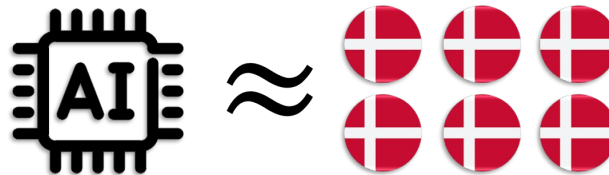
running GPT-3 inference for 10-50 queries consumes 500 millilitres of water

Across the US, data center water consumption is already estimated at 1.7 billion litres per day.



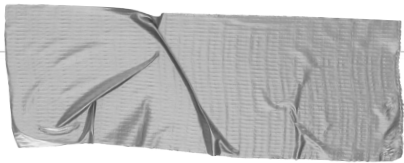
Global AI's Scope 1 & 2 Water Withdrawal in 2027

Est. **4.2~6.6** Billion Cubic Meters



4~6x Annual Water Withdrawal of Denmark

**How bad is it to
manufacture for AI?**



Data Centers - GPUs and waste

The new Blackwell GPU will have 208 billion transistors compared to the current 80 billion.

An estimate of 1.5 million units have been sold in 2023, and the predictions for following years are also in the single digit millions.

One A100 unit produces 0.15 tonnes CO2 emissions

There is a need for a lot more transparency in this area!

Data Centers Almost Sole Driver of Nvidia's Revenue Boom

Nvidia quarterly revenue by segment (in million U.S. dollars)



Source: Nvidia



statista

Natural Resources

CO2eq Emissions

Water Withdrawal

But it's not all bad...

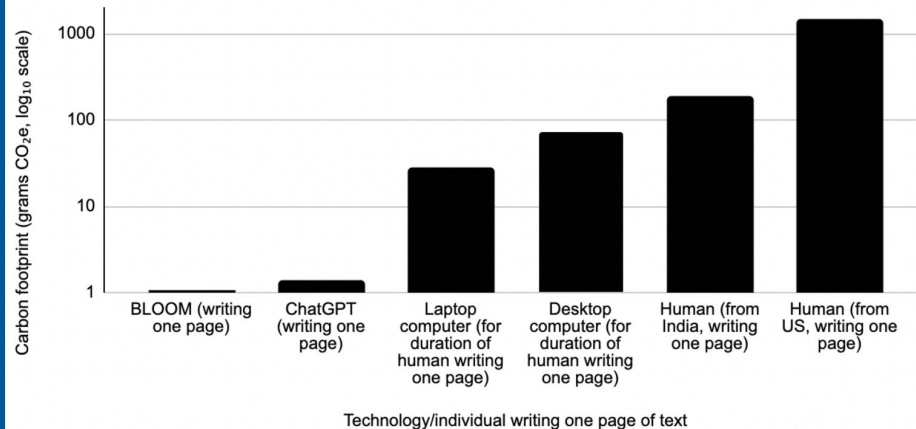


But..

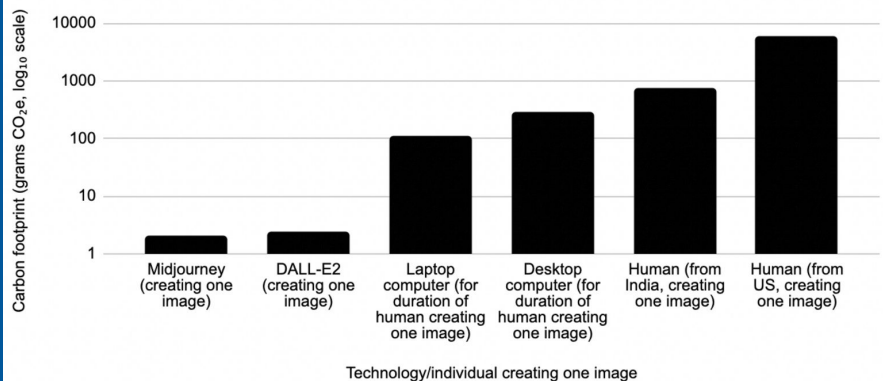
Typical tasks using an LLM might be significantly less than humans performing the same task !

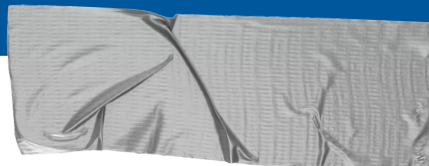
[nature.com](https://www.nature.com)

Carbon footprint (grams CO₂e) for Text Writing



Carbon footprint (grams CO₂e) for Image Creation





Then what?

→ **Monitoring**

The carbon and water footprint of AI and data centers.

→ **Transparency**

Publish all relevant information, because your users deserve to know.

→ **Environmental goals baked-in**

Environmental impact should be part of design/ innovation phase not in the feedback stage.

Extra References

- <https://www.visualcapitalist.com/carbon-footprint-daily-activities/>
- <https://clevercarbon.io/>
- <https://ourworldindata.org/co2-and-greenhouse-gas-emissions>
- <https://arxiv.org/pdf/2311.16863>
- <https://www.componentsense.com/blog/the-link-between-ai-electronics-and-sustainability>
- <https://chinawaterrisk.org/resources/analysis-reviews/8-things-you-should-know-about-water-and-semiconductors/>
-



Tip

There's a lot of research being done on the environmental impact of AI, and IT in general, and there's many hidden aspects.

Let's keep an eye out!

Advertisement



**RSE WG to further research the
environmental impact of “IT”**

First meeting in January 21st @ 2 PM

Current members: Valerian, Charlotte, Ahmed
