Environmental Impact of Large Language Models

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Impact of AI and High-Performance Computing

FORBES > INNOVATION

The Gigawatt Era: From Hyperscale To Exascale

Forbes

Phillip Marangella Forbes Councils Member Forbes Technology Council COUNCIL POST |

Note: Argonne National Laboratory's latest supercomputer, *Aurora*, > 1 exaflop performance with 60^{*} megawatts

* Amount of power installed, not necessarily used

-But what's been **largely left unaddressed** is the effect AI and highperformance computing (HPC) technologies will have—indeed, are already having—on the design, scale and operations of data centers.



Growing Demand of AI across all Domains





Computational Requirements over Time



Training compute (FLOPs) of milestone Machine Learning systems over time



Energy Demands of Training LLMs

Year	OOMs	H1005- equivalent	Cost	Power	Power reference class	
2022	~GPT-4 cluster	~10k	~\$500M	~10 MW	~10,000 average homes	← Winnetka, IL
~2024	+1 OOM	~100k	\$billions	~100MW	~100,000 homes	← Boulder, CO
~2026	+2 OOMs	~1M	\$10s of bil- lions	~1 GW	The Hoover Dam, or a large nuclear reactor	← San Francisco, CA
~2028	+3 OOMs	~10M	\$100s of billions	~10 GW	A small/medium US state	← New York, NY (during peak hours)
~2030	+4 OOMs	~100M	\$1T+	~100GW	>20% of US electricity production	← Japan
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What does this all mean in terms of Impact?

- Meta states they use a 10:20:70 rule for power (experimentation, training, inference)
- Meta states it took <u>916K GPU hours of computation on H100-80GB</u> (<u>TDP of 700W</u>) to train the model (Llama 3.2)

Experimentation (10)	Training (20)	Inference (70)
~320 MWh \$32,000 electric cost 128K kg CO ₂ ~300 round trip flight ORD to SFO ~0.6K trees/yr	0.7kWh * 916,000 GPU hours = 641,200 kWh ~640 MWh \$64,000 electric cost $256K \text{ kg CO}_2$ ~600 round trip flight ORD to SFO ~1.2K trees/yr	~2,240 MWh \$224,000 electric cost 896K kg CO ₂ ~2K round trip flight ORD to SFO ~4K trees/yr



Thank you!

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This presentation used ~20 Queries to ChatGPT4o, yielding an energy consumption of ~6 kWh and carbon impact of ~2.4 kg CO₂ \approx 6 miles in an average car.