# ARTIFICIAL INTELEIGENCE AND CARBON FOOT PRINT- HIDDEN TRUTH

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**ABSTARCT:**

*Even though the entire world is looking for artificial intelligence and its usage for more productivity, efficiency in ever growing competitive environment bot in service and manufacturing sectors. Most of corporates, consumers and beauracrats are overwhelmed with the exceptional advantages of AI.  But it is often overlooked relationship between artificial intelligence (AI) and carbon footprint, shedding light on both the potential environmental challenges posed by the widespread adoption of AI technologies. The absence of standardized methods for quantifying AI-related emissions has been a significant gap in understanding its environmental impact. While the pollution generated during the training of AI models is well-documented, the emissions stemming from AI usage have been overlooked until now. This paper provides insights into what AI can do to carbon footprint? And how it is going to add its share in increasing the carbon footprint and how stakeholders can navigate the complex landscape of AI while minimizing its environmental footprint.*

*Key words: Artificial Intelligence, Environment, Carbon Footprint, AI Models, Impact*

## INTRODUCTION

 "Artificial intelligence" is a broad term that refers to any type of computer software that engages in humanlike activities – including learning, planning and problem-solving. Calling specific applications "artificial intelligence" is like calling a car a "vehicle" – it's technically correct, but it doesn't cover any of the specifics. To understand what type of AI is predominant in business, we have to dig deeper. . It encompasses a wide range of technologies and applications, including machine learning, natural language processing, computer vision, robotics, and more.

**Artificial intelligence (AI) and its growing role in various industries**.

AI systems are projected to enhance labor productivity, optimize supply chains, advance medical care, stimulate economic growth, and contribute to addressing environmental challenges such as global warming. AI's growing role in various industries is transforming how businesses operate and how people interact with technology. Here's a brief overview of its impact across sectors:

**Healthcare:** AI is revolutionizing healthcare by aiding in diagnostics, personalized treatment plans, drug discovery, and patient care. Machine learning algorithms can analyze medical images, predict patient outcomes, and identify patterns in large datasets to improve decision-making by healthcare providers.

**Finance:** In finance, AI is used for fraud detection, algorithmic trading, risk assessment, customer service through chatbots, and personalized financial advice. AI-powered algorithms analyze market trends and customer behavior to optimize investment strategies.

**Retail:** AI enhances the retail experience through personalized recommendations, inventory management, supply chain optimization, and customer service automation. Chatbots and virtual assistants provide round-the-clock support, while computer vision enables cashier-less checkout systems.

**Manufacturing:** AI-driven automation streamlines production processes, improves quality control, and enhances predictive maintenance in manufacturing. Robots equipped with AI capabilities can perform complex tasks with precision and efficiency.

**Transportation:** In transportation, AI is used for route optimization, autonomous vehicles, predictive maintenance of infrastructure and vehicles, and traffic management systems. Self-driving cars and trucks are a prominent example of AI's impact in this sector.

**Marketing:** AI enables targeted advertising, customer segmentation, sentiment analysis, and predictive analytics in marketing. Marketers use AI to understand consumer behavior, personalize campaigns, and optimize marketing spend.

**Education:** AI is transforming education through personalized learning experiences, adaptive tutoring systems, and automated grading. AI-powered platforms analyze student performance data to tailor educational content and support individualized learning paths.

**Energy:** AI helps optimize energy production and distribution, monitor infrastructure for maintenance needs, and enhance renewable energy technologies. Smart grids equipped with AI algorithms improve energy efficiency and reliability.

**Security:** AI is utilized for threat detection, cybersecurity, surveillance, and fraud prevention in various industries. Machine learning algorithms can analyze vast amounts of data to identify anomalies and potential security breaches.

**The Nexus of AI and Environmental Sustainability**

There is no doubt that AI will definitely help in reducing the carbon footprintgs. AI-powered systems, equipped with real-time and precise data, facilitate enhanced decision-making and optimization of transportation routes, thereby fostering substantial cost reductions, heightened efficiency, and diminished carbon emissions. The integration of artificial intelligence (AI) can play a pivotal role in combating climate change. Current AI technologies encompass functionalities such as weather forecasting, iceberg tracking, and pollution detection. Moreover, AI holds promise in refining agricultural practices to mitigate environmental footprint, as highlighted by the World Economic Forum.

AI tools can be tailored to identify greenhouse gas (GHG) leaks in pipelines, oversee deforestation, and aid in the development of innovative materials with reduced carbon footprints, among other climate-conscious applications.

- However, one needs to answer what is the actual energy consumption of AI in realizing these advantages?
- Is the environmental toll of AI energy usage presently outweighing or underscoring the benefits it offers in the fight against climate change?

If employing AI leads to increased carbon emissions that exacerbate climate change, experts have initiated discussions around this issue, and the conclusions are far from comforting.

Unfortunately, there is a lack of available data regarding the carbon footprint of AI, with little to no documentation existing. Additionally, AI companies like Open AI are not providing full transparency regarding the expenses associated with developing their systems, running deep learning algorithms, and training their large language models (LLMs). Assessing the environmental ramifications of large language models (LLMs) poses significant challenges, as the companies behind their development often exhibit reluctance to openly disclose details about their training and retraining processes. It's unfortunate that the companies accountable for developing these models often show reluctance in openly discussing the methods used for their training and retraining.

The datasets utilized for training AI are growing in size, demanding substantial energy resources to operate. According to the MIT Technology Review, the training of a single AI model can result in emissions exceeding 626,000 pounds of carbon dioxide equivalent – an amount nearly fivefold the lifetime emissions of an average American car. As AI models advance in capabilities and intricacy in the coming years, so too will their requirements for processing power and energy consumption. According to a research firm's projection, by 2028, computing performance is expected to quadruple, while processing workloads are predicted to surge by 50-fold. This surge will be driven by heightened utilization, more complex queries, and the development of increasingly sophisticated models with significantly more parameters. It was also found that training GPT-3, which comprises 175 billion parameters, consumed 1287 MWh of electricity and generated carbon emissions totaling 502 metric tons, akin to driving 112 gasoline-powered cars for a year.

A standard coal-fired power plant, operating continuously for 24 hours, consumes approximately 2.7 million pounds of coal.Training Large Language Models (LLMs) is thus analogous to burning coal for 10 consecutive hours, or almost half a day. Significantly, these models undergo recurrent training: it is imperative for LLMs to undergo systematic training on the latest data not only to maintain their relevance and precision but also to achieve continuous enhancements over time.

Energy consumption in data centers is associated both with electricity use, as well as with the continuous, 24/7 use of hefty air conditioners, without which computers and servers would overheat. The AI sector is heavily dependent on data centers, and its increasing use and dissemination will inevitably raise data center carbon emissions over the next several years.

After models are deployed, the process of inference—where the AI makes predictions about new data and responds to queries—can potentially consume even more energy than training. Google has estimated that of the energy utilized in AI for both training and inference, 60 percent is allocated to inference, while 40 percent is dedicated to training. The daily carbon footprint of GPT-3 has been approximated to be equivalent to 50 pounds of CO2, or 8.4 tons of CO2 over a year.

The energy consumption of inference tasks in AI, like those handled by Chat GPT, presents a significant concern due to their frequent usage by millions of users. Within just two months of its launch, Chat GPT attracted 100 million active users, showcasing the widespread adoption of AI-driven solutions for various tasks. However, this popularity comes with an environmental cost, as evidenced by comparisons showing that a single request in Chat GPT can consume substantially more energy than a typical Google search.

Data centers, which support these AI operations, contribute to this energy usage through both electricity consumption and the continuous operation of cooling systems necessary to prevent overheating. While specialized hardware plays a significant role in energy consumption, it's important not to overlook the additional energy required to power servers and other essential equipment.

Experience with Large Language Models like GPT-4 reveals that users often need to submit multiple queries or prompts to obtain satisfactory responses, leading to increased energy consumption. Additionally, there's a tendency for users to experiment with the limits of these models, further exacerbating their carbon footprint.

As AI becomes increasingly integrated into search engines, the demand for computing power to train and operate models is expected to rise. Experts suggest that this could lead to a significant increase in both the computing power required and the energy consumed, potentially up to five times more per search compared to conventional methods.

**CAN AI BE MADE GREENER?**

Addressing the energy and environmental challenges associated with AI requires a multifaceted approach involving technological innovation, regulatory frameworks, and strategic decision-making. With concerted efforts and forward-thinking initiatives, AI can indeed contribute positively to environmental sustainability in the long term.

- **Model Modification Techniques:** Rather than continually developing larger models, fine-tuning existing ones and removing redundant parameters through techniques like network pruning can enhance efficiency without sacrificing performance. Knowledge distillation, which transfers learned knowledge from large models to compact ones, further reduces energy consumption by minimizing computational requirements.

- **Innovative Cooling Solutions:** Traditional cooling methods like air conditioning are being replaced by more energy-efficient alternatives such as liquid immersion cooling. Microsoft's research into using a specialized fluid to cool computer processors demonstrates significant energy savings compared to conventional cooling methods. Additionally, exploring unconventional cooling solutions like underwater data centers, harnessing natural ocean currents and wind turbines for renewable energy, offers promising avenues for reducing energy consumption.

- **Government Support and Regulation:** Governments play a crucial role in promoting sustainable AI development through regulations ensuring transparency and accountability for carbon emissions. Tax incentives can encourage cloud providers to prioritize renewable energy sources for data centers, fostering the expansion of clean energy grids. Leadership and thoughtful governance are essential for leveraging AI's potential to achieve significant energy savings and environmental benefits.

- **Transparency:** A crucial initial step involves enabling developers and organizations to accurately measure the electricity consumption of their computing systems and its corresponding carbon emissions. Standardizing the measurement of AI carbon footprints allows for meaningful comparisons between different systems.

- **Renewable Energy Adoption:** Major cloud providers, including Microsoft, have committed to transitioning their data centers to operate entirely on carbon-free energy by 2030, with some already achieving this goal. By securing long-term contracts for renewable energy sources, such as wind and solar power, these companies are reducing their environmental impact significantly. Moreover, relocating resource-intensive tasks to data centers powered by clean energy grids, like the French supercomputer fueled mainly by nuclear energy, can substantially minimize carbon emissions compared to conventional approaches.

- **Efficient Computer Management:** Enhancing the energy efficiency of data centers, which often house thousands of computers, is imperative. Optimizing workload distribution across these systems can reduce electricity consumption, potentially eliminating the need for excess computing resources. Research efforts are exploring the energy-saving benefits of operating computers at lower speeds during non-urgent tasks,

along with the optimization of computational accuracy to improve efficiency without compromising performance.

- **Advanced Hardware Design:** Specialized hardware, such as Google's tensor processing units tailored for training large language models, offers enhanced speed and energy efficiency compared to conventional GPUs. Companies and researchers are actively developing more efficient hardware specifically designed for AI applications, aiming to further reduce energy consumption.

- **Algorithmic Optimization:** Identifying and implementing the most efficient algorithms for specific tasks based on factors like data volume and computational resources is essential. By optimizing algorithms and leveraging experience-driven efficiencies, significant energy savings can be achieved. Additionally, adopting smaller AI models tailored to the specific requirements of tasks can substantially reduce energy consumption compared to deploying large, generalized models for every application.

## CONCLUSION:

As AI models become increasingly complex and companies allocate greater resources to their development and training, the environmental footprint of AI is expected to expand. While AI holds immense potential, it's essential to conscientiously acknowledge and mitigate its environmental impact. Calculating the precise impact of AI on the climate crisis proves challenging, particularly when focusing solely on greenhouse gas emissions. This complexity arises from the diverse nature of AI applications, each requiring varying amounts of computing power for training and operation. For instance, training OpenAI's GPT-3 large language model (LLM) resulted in huge emissions of carbon dioxide, while simpler models emit significantly fewer emissions. Additionally, the lack of transparency from numerous AI companies further complicates efforts to assess the environmental impact of their models, especially when viewed solely through the lens of emissions. As nations worldwide grapple with regulating the AI sector, there must be heightened emphasis on achieving complete transparency, especially concerning the carbon emissions linked to AI operations.

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