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How Developers Can Lower AI's Climate Impact

Assignment Summary:

AI development is energy-intensive, contributing to carbon emissions. Developers can reduce AI's environmental impact by optimizing model architectures, using energy-efficient hardware, adopting cloud computing with clean energy, and reusing models. Strategies like federated learning, energy-aware scheduling, and sourcing renewable power can make AI more sustainable and eco-friendly.

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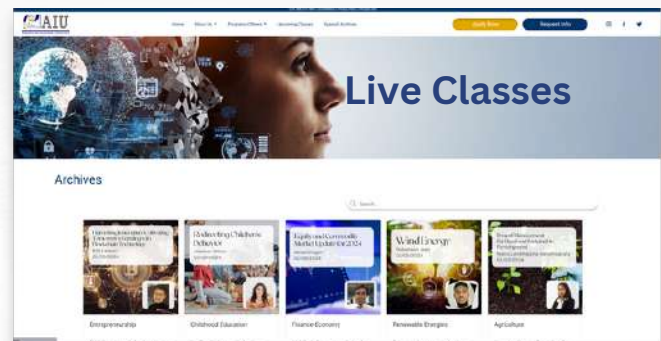
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AI development is booming, driving innovation across industries and playing a vital role in areas like natural language processing, image recognition, and even climate science. However, this rapid growth comes with a significant environmental cost. The public release of large language models (LLMs) such as ChatGPT has raised concerns about the power-hungry nature of AI training and deployment. A case in point: training the open multilingual language model BLOOM resulted in approximately 24.7 tons of carbon emissions. As AI scales, so does its energy appetite, raising questions about its impact on global sustainability efforts.

While AI can be a valuable tool for driving environmental goals like reducing emissions and optimizing resource management, it can also become a drain on those same efforts if left unchecked. Fortunately, there are strategies that developers can use to mitigate AI's carbon footprint and make AI systems more energy-efficient.

Source: Aranca

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Understanding AI's Carbon Impact

Quantifying AI's carbon footprint isn't straightforward. While energy consumption during AI training is well-recognized, energy used during deployment is less understood. Most AI companies do not disclose energy consumption metrics, which hinders efforts to measure and reduce their impact. However, several tools are emerging to fill this gap:

- **Software Carbon Intensity (SCI) specification**: Developed by the Green Software Foundation, this framework provides a way to estimate and track a project's carbon emissions baseline over time.
- **Green Algorithms Project**: This calculator helps estimate total emissions for AI projects.
- **Cloud Provider Carbon Tools**: Amazon Web Services (AWS), Google Cloud Platform, and Microsoft Azure offer carbon-tracking tools specific to their platforms.
- **Stanford University's ML Framework**: In collaboration with industry experts, Stanford researchers have published a lightweight framework to report energy use, compute resources, and carbon impacts for machine learning systems.

While measurement is the first step toward addressing AI's environmental impact, making significant progress requires targeting the entire AI lifecycle.

Tackling the AI Lifecycle: Rethink, Reuse, Reduce

To make AI development more sustainable, developers must rethink how they build, train, and deploy models. Addressing each stage of the AI lifecycle can lead to substantial gains in both efficiency and sustainability.

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A **joint study** by Google and the University of California, Berkeley demonstrated how AI's energy consumption can be slashed up to 100x by adopting four key practices:

1. **Efficient ML Architectures**: Sparse models, for example, are more efficient than dense models in certain tasks.
2. **Specialized Hardware**: Using ML-optimized hardware like tensor processing units (TPUs) or modern GPUs, instead of general-purpose processors, reduces energy needs.
3. **Cloud Computing**: Utilizing the cloud for training and deployment improves data center efficiency and access to clean energy sources.
4. **Energy-efficient Data Centers**: Choosing cloud locations that use clean energy can cut CO2 emissions up to 1,000x.

Beyond these strategies, the core approach for sustainability should focus on three actions: rethink, reuse, and reduce. By rethinking AI workflows, reusing pre-trained models, and reducing redundant or energy-heavy processes, developers can create more value with fewer resources.

Source: MSN

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5 Ways to Develop More Sustainable AI

Developers have the power to lower AI's environmental impact through strategic decision-making and technology choices. Here are five actionable steps for building more eco-friendly AI systems.

1. Make AI as Efficient as the Human Brain

Composite AI mimics the efficiency of the human brain by using network structures like knowledge graphs and causal networks. These methods allow AI to solve more complex problems with less computational overhead, reducing energy consumption.

2. Put AI on a Health Regimen

- Monitor Energy Usage: Track energy consumption during training and stop when further improvements flatten out.
- Federated Learning: This approach keeps data localized for training but shares improvements globally, cutting down energy use and enhancing privacy.
- Reuse Models: Avoid training models from scratch. Instead, fine-tune existing models and contextualize them for specific applications.
- Energy-efficient Hardware: Opt for hardware designed for low-power operation, minimizing the energy footprint.

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3. Run AI in the Right Place at the Right Time

- Job Scheduling: Schedule AI workloads based on the carbon intensity of local energy supplies, which can vary by time and place.
- Follow-the-sun and Unfollow-the-sun: Adjust data center workloads according to when and where renewable energy is most available. For example, certain regions or times of day may have lower carbon energy, making those periods ideal for energy-intensive tasks.
- Energy-aware Scheduling: Use carbon tracking and forecasting tools to run AI jobs when energy demand is lower or cleaner energy is available.

4. Source Clean Power Strategically

Where possible, procure power purchase agreements (PPAs) or renewable energy certificates (RECs) to offset carbon emissions. By securing clean power sources close to where your AI workloads run, you can actively reduce emissions.

5. Prioritize Environmental Impact in AI Use Cases

- Balance Business and Environmental Value: When building AI models, weigh the potential environmental impact against business gains. Focus on use cases that create more value than they destroy.
- Improve Existing Models: Before deploying new AI initiatives, work to make existing ones more energy-efficient.
- Avoid High-risk AI Projects: If a use case could significantly harm the environment or fail to deliver enough value, it's worth reconsidering.

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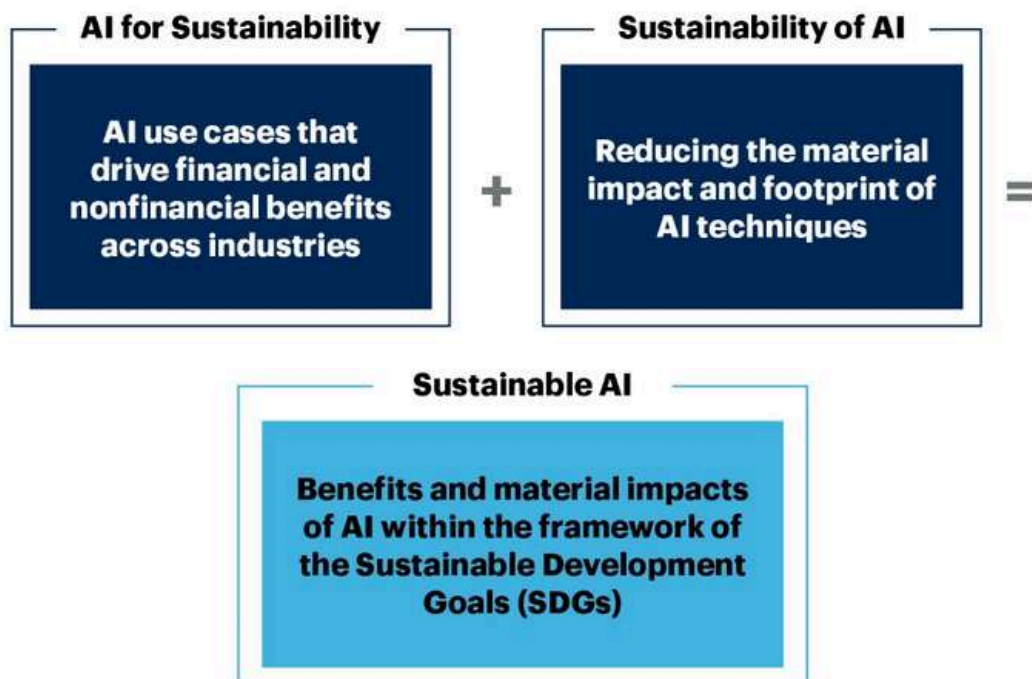
Two concepts defining sustainable AI
Source: Gartner

The Bigger Picture: AI's Resource Hunger

According to **Gartner**, AI data centers already account for approximately 2% of U.S. electricity use, consuming significantly more energy per square foot than typical commercial buildings. And the impact goes beyond electricity—training large AI models like GPT-4 requires enormous amounts of water to cool the servers. One recent study suggested that answering 20-50 ChatGPT queries might consume the equivalent of a 500ml bottle of water.

Globally, AI's energy and water demands are expected to skyrocket. By 2026, AI-driven data centers could use 1,000 terawatts of electricity—equivalent to Japan's total consumption—and require 4.2-6.6 billion cubic meters of water by 2027. These demands intensify the environmental challenge.

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Conclusion: A Path Toward Sustainable AI

While the transition to 100% renewable energy may seem distant, immediate strategies for reducing AI's carbon footprint are available. By using specialized hardware, improving software efficiency, and optimizing data center operations, developers can make AI more sustainable. Additionally, as AI continues to drive digital transformation, policies and regulations will play a critical role in ensuring its development is aligned with global climate goals.

The journey to a greener AI future starts with smarter decisions today. By rethinking AI design, reusing existing models, and reducing unnecessary energy consumption, developers can help mitigate AI's growing climate impact.

If this article triggers any interest in knowing how developers can help in reducing AI's climate impact, then AIU offers a list of Mini courses, Blogs, News articles and many more on related topics that one can access such as:

Earth's Climate Faces Risk of No Return If Warming Exceeds 1.5°C: A Tipping Point Analysis
Understanding Climate Change: A Call to Action for a Sustainable Future

AIU also offers a comprehensive array of recorded **live classes** spanning various subjects. If any topic piques your interest, you can explore related live classes. Furthermore, our expansive **online library** houses a wealth of knowledge, comprising thousands of e-books, thereby serving as a valuable supplementary resource.

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AI with coding github copilot and chat gpt by Jay Vijayasimha

The Climate Fresco by Niavo Landihajaina R

The chemistry of climate change by Tyler Gleckler

Breaking Open AI's Black Box

AI Needs You: How We Can Change AI's Future and Save Our Own

AI Aims for Real

Drilling Down on AI's Impact

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The carbon impact of artificial intelligence | Nature Machine Intelligence
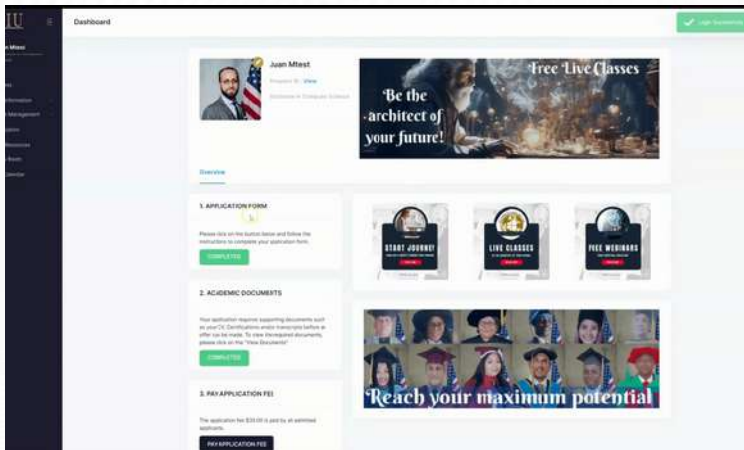
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