May 25, 2025

Dear Editors,

We are pleased to submit our manuscript entitled *"Scenario-based forecasting of artificial intelligence's global energy demand and carbon footprint"* for consideration in *Renewable and Sustainable Energy Reviews*. This study presents a scenario-based modeling framework for assessing the long-term global energy demand and life-cycle emissions of artificial intelligence (AI), integrating mathematical forecasting with multi-regional input-output (MRIO) analysis.

Our findings suggest that, under business-as-usual conditions, AI could account for up to 30% of global electricity demand and emit over 8 gigatons of CO_2-equivalent annually by 2050. The analysis reveals that energy efficiency improvements alone may not offset the rapid acceleration in AI adoption and model complexity. To address this, we present six development pathways combining different scaling strategies and energy mix trajectories, offering insight into the potential policy levers for aligning AI growth with global decarbonization goals.

This work contributes to RSER's scope by extending life-cycle energy assessment to the digital sector, an increasingly important yet underexamined driver of future energy demand. Our methodology introduces a transparent and reproducible approach to estimating electricity use and supply-chain-related emissions in AI systems, incorporating regional differences in energy sourcing, hardware production, and digital infrastructure. A novel element of our work is the identification of geographic decoupling between AI users and emissions, highlighting equity implications in future carbon responsibility.

The manuscript is original and has not been published elsewhere. It was submitted to *Nature* for publication but was not accepted. It includes supplementary materials and code repositories to support reproducibility. We believe the study will be of interest to RSER's readership in energy modeling, sustainability transitions, and policy analysis.

Recent RSER publications have addressed the intersection of AI with energy systems, including the use of AI in energy demand-side management [1], energy management in smart buildings [2], and integrated digital infrastructure for sustainable energy transitions [3]. Our study complements these works by specifically focusing on the energy and carbon implications of scaling AI itself, a crucial yet underexplored aspect of global decarbonization pathways.

Thank you for your consideration. We look forward to the opportunity to contribute to your journal.

Sincerely,

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References

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