ARTIFICIAL INTELLIGENCE: A CATALYST FOR ACHIEVING NET ZERO

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Abstract:

Artificial Intelligence (AI) is increasingly recognized as a powerful tool in the global effort to achieve net zero emissions. This paper explores the multifaceted role of AI in accelerating the transition to a carbon-neutral future. AI technologies can enhance energy efficiency, optimize renewable energy production, and facilitate smarter grid management. By enabling predictive maintenance and improving the accuracy of climate modeling, AI contributes to more effective mitigation strategies. Additionally, AI-driven insights can foster sustainable industrial processes and promote the adoption of green technologies. However, the deployment of AI also presents challenges, including data privacy concerns, the need for substantial computational resources, and the risk of exacerbating existing inequalities. Addressing these challenges through robust policy frameworks and ethical guidelines is essential to harness AI's full potential. This paper underscores the importance of interdisciplinary collaboration to leverage AI as a catalyst for achieving net zero, ensuring a sustainable and equitable future. Artificial Intelligence (AI) is poised to play a pivotal role in the global pursuit of net zero emissions. AI technologies offer innovative solutions to some of the most pressing challenges in climate change mitigation. This review article explores the various applications of AI in achieving net zero, highlights the benefits and challenges of integrating AI into climate strategies, and underscores the need for robust policy frameworks to ensure ethical and effective use of AI.

Keywords: AI, renewable energy, carbon-neutral future, climate strategies.

Introduction:

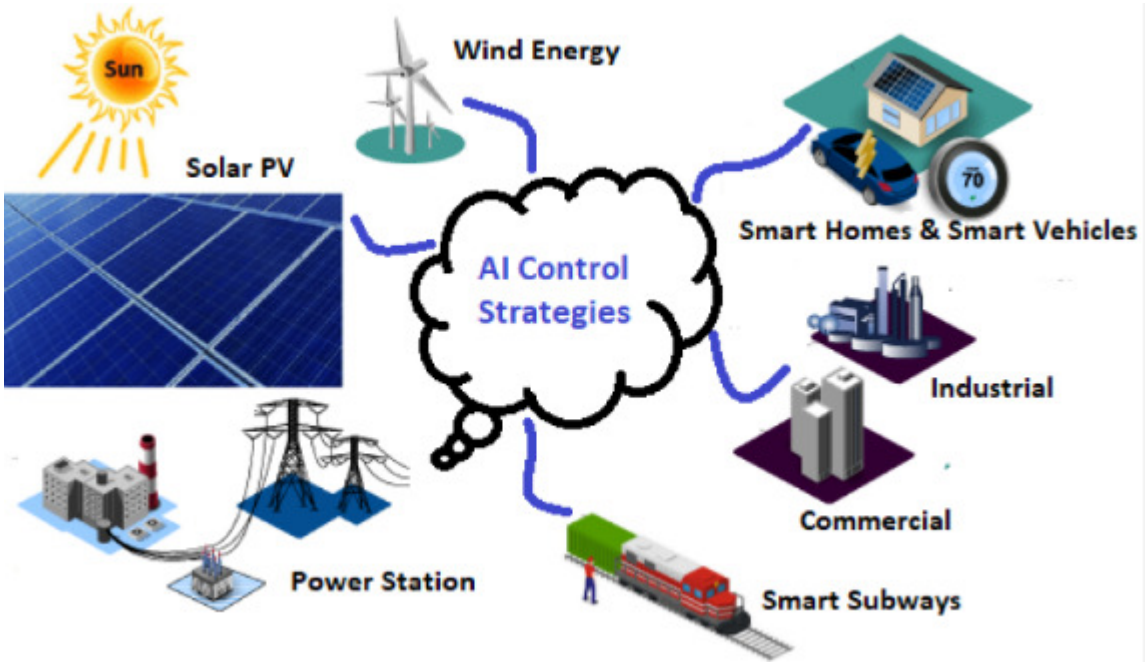
Net zero means the balance between the amount of greenhouse gases emitted into the aerosphere and the amount removed from it. Achieving net zero means that any human-caused emissions are counterbalanced by an equivalent amount of removal, resulting in no net increase in atmospheric greenhouse gases. This can be accomplished through a combination of reducing emissions from sources such as burning fossil fuels and industrial processes, and enhancing natural or technological methods for carbon capture and storage. The goal of net zero is to mitigate the impacts of climate change by stabilizing global temperatures and preventing further environmental degradation (Fankhauser et al., 2022).

Artificial Intelligence (AI) is the development of computer systems that can perform tasks that typically require human intelligence. These tasks include learning, reasoning, problem-solving, perception, and language understanding. AI aims to create machines capable of adapting and improving their performance over time, often utilizing techniques like machine learning and neural networks. The field has diverse applications, from virtual assistants and autonomous vehicles to healthcare and finance, shaping the way we interact with technology and the world around us (Helder et al., 2023).

AI in Energy Management

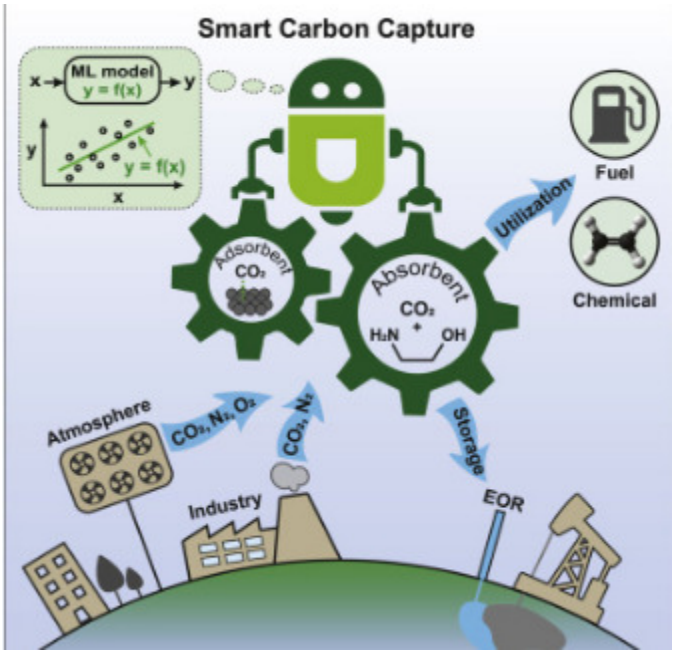
AI enhances energy efficiency by optimizing the generation, distribution, and consumption of energy. Smart grids, powered by AI, can predict energy demand and adjust supply in real-time, reducing waste and ensuring a more efficient use of resources. AI algorithms can also improve the performance of renewable energy sources such as wind and solar by predicting weather patterns and optimizing energy storage and distribution (Johnny wood, 2021).

Renewable Energy Optimization



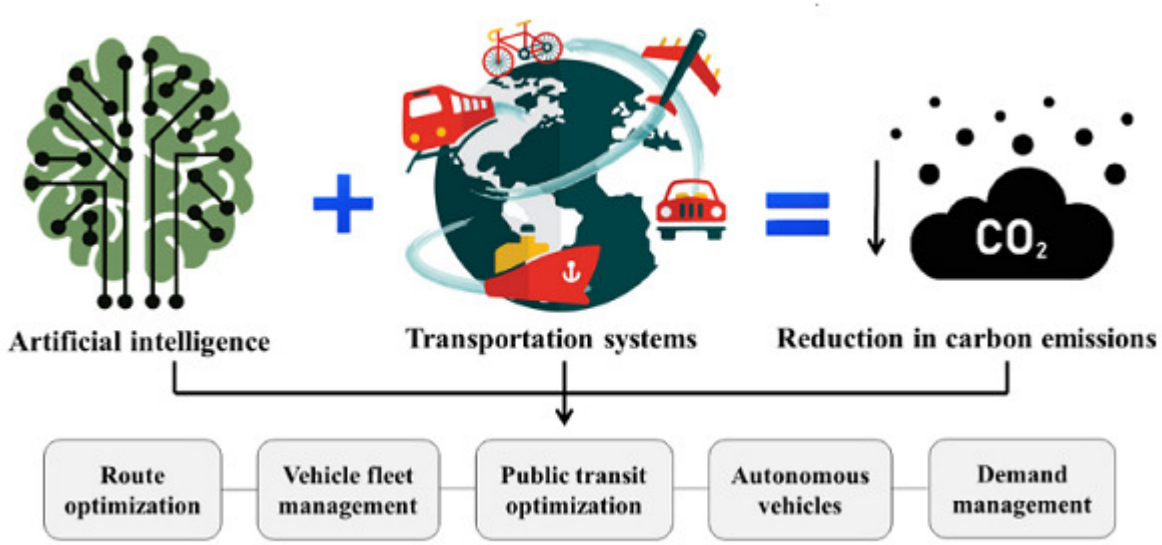
Renewable energy systems benefit significantly from AI's predictive capabilities. For instance, machine learning models can forecast solar irradiance and wind speeds, allowing for better integration of these intermittent energy sources into the grid. AI-driven maintenance schedules can predict and address equipment failures before they occur, thereby minimizing downtime and maintaining continuous energy production. (Mckinsey & company,2022)

Carbon Capture and Storage



AI can optimize carbon capture and storage (CCS) technologies, which are essential for reducing emissions from industries that are difficult to decarbonize, such as cement and steel production. Machine learning algorithms can analyze data from CCS processes to improve the efficiency and reduce the costs of capturing and storing CO2. Additionally, AI can help identify optimal geological sites for CO2 storage, ensuring long-term stability and safety.

Transportation



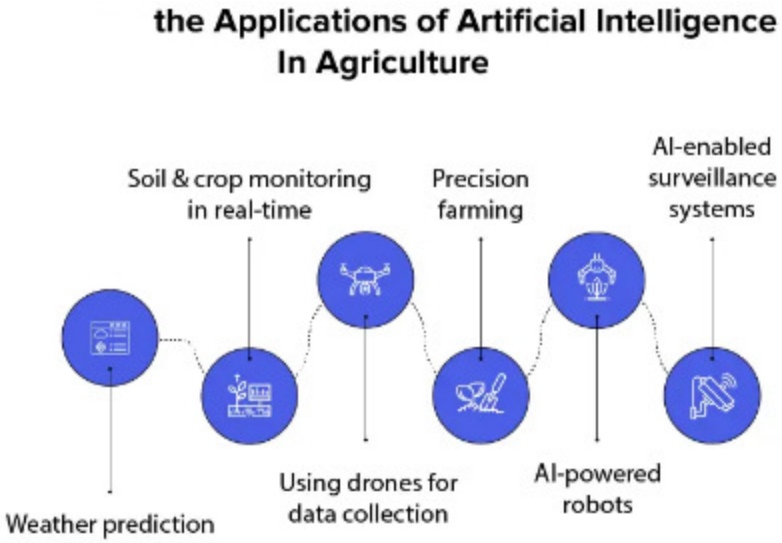
The transportation sector is a major contributor to greenhouse gas emissions. AI can help reduce these emissions by optimizing routes, improving fuel efficiency, and supporting the development of autonomous electric vehicles. AI-driven traffic management systems can reduce congestion and emissions in urban areas by dynamically adjusting traffic signals and providing real-time route recommendations.

Industry and Manufacturing

In industry and manufacturing, AI can streamline processes, reduce waste, and enhance resource efficiency. AI-powered predictive maintenance can prevent equipment failures, reducing downtime and energy consumption. AI can also optimize supply chains by predicting demand and reducing the carbon footprint associated with logistics and transportation

Agriculture

AI applications in agriculture can lead to more sustainable farming practices. Precision agriculture, enabled by AI, allows for the efficient use of water, fertilizers, and pesticides, reducing emissions and conserving resources. AI can also monitor soil health and crop conditions in real-time, providing farmers with actionable insights to improve yield and reduce environmental impact.



Challenges and Ethical Considerations

While AI offers substantial benefits for achieving net zero, it also presents challenges and ethical considerations. The energy consumption of AI systems themselves can be significant,

necessitating the development of more energy-efficient algorithms and hardware. Data privacy and security are critical concerns, as AI systems often require access to large datasets. Additionally, the deployment of AI must be guided by ethical frameworks to prevent exacerbating existing inequalities and ensure that the benefits of AI are.

References:

Aakash Singh, Anurag Kanaujia, Vivek Kumar Singh(2023), Artificial intelligence for Sustainable Development Goals: Bibliometric patterns and concept evolution trajectories, Wiley, Volume 32, Issue 1**,** p. 724-754**.**

Alaa Khamis,Howard Li, Edson Prestes, Tamas Haidegger(2019), A Key Enabler of Sustainable Development Goals, Part 1, IEEE Robotics & Automation Magazine, Volume: 26.

Asmae El jaouhari [a], Jabir Arif (2023), Net zero supply chain performance and industry 4.0 technologies: Past review and present introspective analysis for future research directions, Volume 9, Issue 11, November 2023, e21525

Assunta Di Vaio, Rosa Palladino, (2020), Artificial intelligence and business models in the sustainable development goals perspective: A systematic literature review, Elsevier, Volume 121, https://doi.org/10.1016/j.jbusres.2020.08.019.

Bingbing Fang, Jiacheng Yu, Zhonghao Chen, Ahmed I. Osman, Mohamed Farghali, Ikko Ihara, Essam H. Hamza, David W. Rooney & Pow-Seng Yap (2023), AI Application to Pollution Reduction and Waste Management Toward Net Zero: A Systematic Review,15 October 2023 https://doi.org/10.3303/CET23103084

Fankhauser, Sam; Smith, Stephen M.; Allen, Myles; Axelsson, Kaya; Hale, Thomas; Hepburn, Cameron; Kendall, J. Michael; Khosla, Radhika; Lezaun, Javier; Mitchell-Larson, Eli; Obersteiner, Michael; Rajamani, Lavanya; Rickaby, Rosalind; Seddon, Nathalie; Wetzer, Thom (2022). "The meaning of net zero and how to get it right". Nature Climate Change. **12** (1): 15 21. Bibcode:2022NatCC..12...15F. doi:10.1038/s41558-021-01245-w

Harsha Moraliyage (2022),A Robust Artificial Intelligence Approach with Explainability for Measurement and Verification of Energy Efficient Infrastructure for Net Zero Carbon Emissions, Sensors 2022, 22(23), 9503; https://doi.org/10.3390/s22239503

Helder R.O. Rocha, Rodrigo Fiorotti , Jair A.L. Silva (2023), net Zero Energy cost Building based on AI. Applied Energy Volume 355, 1 February 2024, 122348.

Jon truby (2020), Governing Artificial Intelligence to benefit the UN Sustainable Development Goals, Wiley, Research article, Volume 28, Issue 4 p. 946-959.

Myles R Allen 1, David J Frame, Chris Huntingford, Chris D Jones, Jason A Lowe, MalteMeinshausen, Nicolai Meinshausen, Warming caused by cumulative carbon emissiontowards the trillionth tonne, nature, 30 April, 2009

PS Bloomfield , P Clutton-Brock(2021) ,Artificial Intelligence in the NHS: Climate and Emissions, The Journal of Climate Change and Health

Ricardo Vinuesa, Hossein Azizpour(2020) ,The role of artificial intelligence in achieving the Sustainable Development Goals, Nature Communications volume 11, Article number: 233 (2020)

The Author(s), 2023. Published by Cambridge University Press, Artificial Intelligence, Climate Change and Innovative Democratic Governance, European Journal of Risk Regulation , Volume 14 , Issue 3 , September 2023 , pp. 484 - 503 DOI: https://doi.org/10.1017/err.2023.60
Volume 4, October 2021, 100056

Waqar Muhammad Ashraf(2022) , Artificial intelligence enabled efficient power generation and emissions reduction underpinning net-zero goal from the coal-based power plants, Energy Conversion and Management 268(21):116025

waqar,gulam(2023),Artificial Intelligence Modeling-Based Optimization of an Industrial-Scale Steam Turbine for Moving toward Net-Zero in the Energy Sector, ACS Omega 2023, 8, 24, 21709–21725 , https://doi.org/10.1021/acsomega.3c01227.

M. Suardi; F. Cannarile; G. Guastone; A. Fidanzi; R. Millini; D. Testa (2023), A Framework for the Application of AI Solutions for Facilitating and Speeding-Up the Industrialization of Innovative R&D Technologies for Targeting Net-Zero Emissions, October 2023. https://doi.org/10.2118/215986-MS

Nishan Mills; Prabod Rathnayaka; Harsha Moraliyage; Daswin De Silva; Andrew Jennings(2022), Cloud Edge Architecture Leveraging Artificial Intelligence and Analytics for Microgrid Energy Optimisation and Net Zero Carbon Emissions, 2022 15th International Conference on Human System Interaction (HSI)

Qusay Hassan, Aws Zuhair Sameen, Hayder M. Salman, Ali Khudhair Al-Jiboory (2023), The role of renewable energy and artificial intelligence towards environmental sustainability and net zero, May 2023, Research Article on Research square

Waqar Muhammad Ashraf, Muhammad Wakil Shahzad , Artificial intelligence enabled efficient power generation and emissions reduction underpinning net-zero goal from the coal-based power plants,August 2022Energy Conversion and Management 268(21):116025

Harsha, Sanoshi, Daswin, Nishan, Prabod& Andrew Jennings ,A Robust Artificial Intelligence Approach with Explainability for Measurement and Verification of Energy Efficient Infrastructure for Net Zero Carbon Emissions, Sensors **2022**, 22(23), 9503; **https://doi.org/10.3390/s22239503**.

K.R. Ullah , V. Prodanovic , G. Pignatta , A. Deletic , M. Santamouris , Technological advancements towards the net-zero energy communities: A review on 23 case studies around the globe, Solar Energy Volume 224, August 2021,https://doi.org/10.1016/j.solener.2021.06.056

.U. Stritih , V.V. Tyagi , R. Stropnik, H. Paksoy, F. Haghighat , M. Mastani Joybari , Integration of passive PCM technologies for net-zero energy buildings, Sustainable Cities and Society Volume 41, August 2018

Rogelj, Joeri; Geden, Oliver; Cowie, Annette; Reisinger, Andy (16 March 2021). "Net-zero emissions targets are vague: three ways to fix". Nature. **591** (7850): 365–368. Bibcode:2021Natur.591..365R. doi:10.1038/d41586-021-00662-3. hdl:10044/1/87657. ISSN 1476-4687. PMID 33727725

https://www.weforum.org/agenda/2021/11/net-zero-emissions-cop26-climate-change/

https://www.mckinsey.com/featured-insights/mckinsey-explainers/what-is-net-zero

https://www.climatecouncil.org.au/resources/what-does-net-zero-emissions-mean/