The Potential of Artificial Intelligence in Addressing Climate Change

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Artificial intelligence (AI) has become an instrumental technology in the fight against climate change, especially in industrial and corporate settings. This study specifically explores how businesses within the facilities management sector have integrated AI technologies to mitigate and adapt to climate challenges. Four expert interviews with corporate leaders who have successfully deployed AI solutions were conducted to identify key challenges, barriers, and success factors in implementing AI-driven climate solutions, and develop recommendations for businesses seeking to leverage AI for climate action. The findings of this study highlight the significant potential of AI in addressing climate change challenges within the facilities management sector, including demand response management, predictive maintenance, smart building optimization, and supply chain decarbonization. Demand response management has effectively reduced peak load stress and significantly lowered annual CO_2 emissions, while predictive maintenance has contributed to a noticeable reduction in energy waste and an extension of machinery lifespan. Key results include the substantial environmental benefits achieved through targeted AI interventions in energy management and the risk mitigation gained from gradual implementation strategies.

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1 Introduction

This study investigates the integration of artificial intelligence in corporate climate strategies, addressing the dual challenge of global warming and technological adaptation through AI-driven solutions in energy and resource management. Another challenge is the proper use of AI applications in addressing climate change, including demand response management, predictive maintenance, smart building optimization, and supply chain decarbonization. These two fields together show the urgent need to articulate new solutions by academics and professionals. For instance, July 2023 was recorded as the hottest month in human history, with the nine warmest years ever documented occurring within the last decade (Moustafa et al., 2023). Severe storms, droughts, floods, and wildfires – all amplified by global warming – have caused extraordinary damage worldwide, while sea-level rise threatens coastal communities globally (Varga & Csiszárik-Kocsir, 2023). Despite the Paris Agreement's call to limit global temperature increases to well below 2°C above pre-industrial levels, the world remains on track for approximately 3°C warming by 2100 (Warren et al., 2022). Not to mention that around 4 billion people already live in areas highly susceptible to climate change, and there are many areas with weak health infrastructure – mostly in developing countries – that will be the least able to cope without assistance to prepare and respond (WHO, 2025).

Climate change affects our health in many ways. It can cause death and illness by disrupting food systems and contributing to mental health problems. Additionally, it weakens important factors for good health, such as jobs, fairness, access to healthcare, and support from our communities (Figure 1). These impacts tend to hit the most vulnerable people the hardest, including women, children, ethnic minorities, poor communities, migrants or those displaced, older adults, and people with existing health issues (McMichale et al., 2011; Rawat et al., 2024).

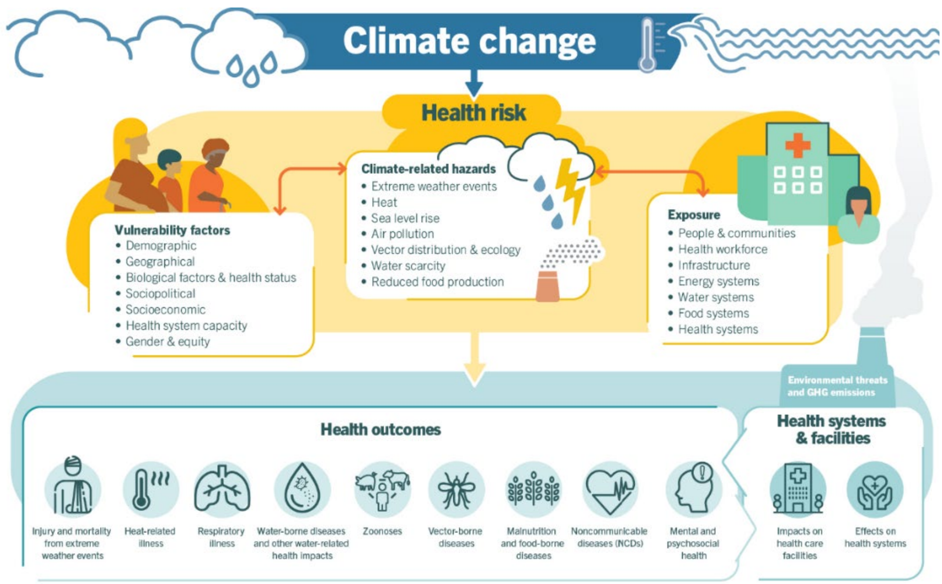

Figure 1: An overview of climate-sensitive health risks, their exposure pathways and vulnerability factors

Source: WHO (2025), Available at: https://www.who.int/news-room/fact-sheets/detail/climate-change-and-health

Figure 1 shows that climate change is presented as a main factor influencing health outcomes through several interconnected elements. Vulnerability factors – such as demographics, geography, socioeconomics, and health system capacity – increase the risk of climate-related hazards like extreme weather, heat, and air pollution. These hazards, in turn, affect people, systems, and communities, creating various exposures and leading to a broad range of health issues, including injuries, illnesses, malnutrition, and mental health challenges. Additionally, the figure also shows how health systems are both impacted by environmental threats and essential in addressing these risks. Disruptions to health facilities can worsen existing inequalities, since vulnerable groups often face greater challenges in accessing care. This highlights the need for stronger and more adaptable healthcare structures.

Based on the abovementioned examples, it can be stated that climate change affects humanity both physically and mentally (Szeberényi, 2023). Hence, this trajectory demands urgent, innovative solutions that transcend conventional approaches. On the technological side, however, artificial intelligence has experienced unprecedented growth and advancement. Many scientists – Fauville et al., 2020; Jain et al., 2023;

Sundberg, 2024; Berde et al., 2025 – mention the urgent need of AI tools and models to tackle the heavy climate change issues. This indeed will be mandatory soon, and we agree with the idea of Lim (2019, p. 814)*, who said "AI has become a cornerstone of innovation that will be the defining technology of our time"*. In 2025, these words could not be more pertinent because AI has begun transforming nearly every major industry through its capacity to analyse vast datasets, identify complex patterns, and generate novel solutions. The convergence of these two global phenomena – climate crisis and technological revolution – presents both significant challenges and extraordinary opportunities for addressing one of humanity's most complex problems.

2 Theoretical Background

Artificial intelligence offers unique capabilities particularly suited to addressing climate change challenges. Climate science inherently involves complex systems analysis, vast data processing requirements, and multivariable prediction – all areas where AI excels. The technology's ability to process enormous datasets and identify non-obvious patterns makes it especially valuable for climate modelling, emissions tracking, and optimization of resource-intensive systems.

Recent advances in AI have enabled significant improvements in climate forecasting, greenhouse gas monitoring, and energy optimization. For instance, AI is improving climate model performance, providing advanced warning of extreme weather events, and helping attribute such events to atmospheric changes.

In the domain of emissions monitoring, AI systems now draw on data from satellites, aircraft, drones, and ground-based sensors, offering sharper insight into greenhouse gas sources than ever before. Meanwhile, these same technologies can measure the melting rates of glaciers and icebergs and identify exactly where melting is occurring (WEF, 2023). Such capacities are remarkable: AI can track iceberg changes up to 10,000 times faster than a human analyst, thereby enhancing our understanding of how much meltwater these ice masses release into the oceans – an issue growing more urgent as climate change warms the atmosphere Scientists at the University of Leeds in the United Kingdom, according to the European Space Agency, report that their AI tools can map large Antarctic icebergs in satellite images in as little as one-hundredth of a second. By contrast, human efforts remain slow and prone to error, especially when distinguishing icebergs from the surrounding whiteness of clouds and sea ice (ESA, 2023).

Another notable area where AI demonstrates exceptional utility is in the precise mapping of environmental changes. AI significantly enhances environmental monitoring by enabling the precise mapping of deforestation. By combining satellite imagery with the ecological expertise of researchers, AI systems effectively delineate deforestation areas and assess its impact on the climate crisis. This integrated approach allows for the accurate measurement of both the extent of forest loss and the quantification of carbon dioxide stored within forest ecosystems (WEF, 2024). Moreover, AI demonstrates considerable potential in the realm of waste recycling, and debris detection – a field critical to mitigating climate change (Figure 2).

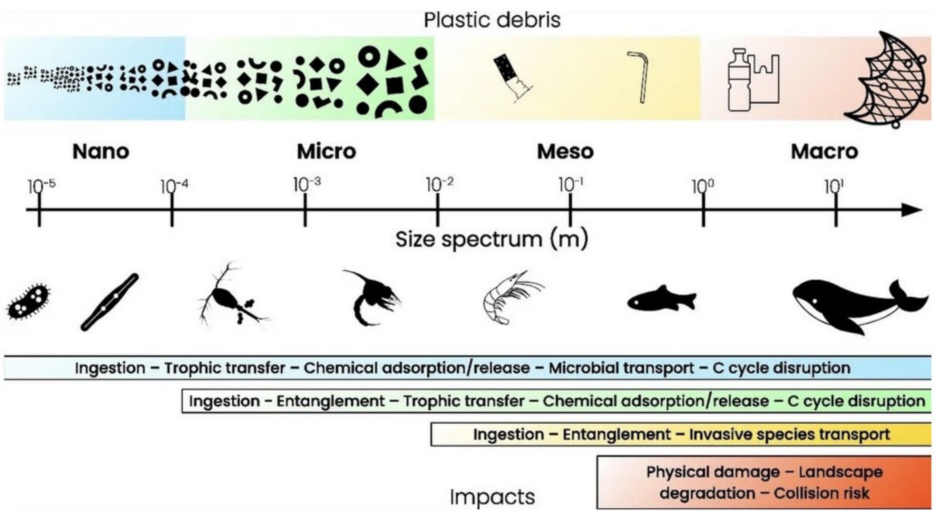

Figure 2: Categories of plastic debris analysed by AI and their impact on the environment
Source: Ocean Cleanup (2023). Available at: https://theoceancleanup.com/updates/lasting-damage-why-cleanup-is-essential-to-tackle-microplastics/

The United States Environmental Protection Agency identifies waste as one of the largest sources of methane emissions, contributing approximately 16% to global greenhouse gas outputs. In response, Greyparrot, a London-based software startup, has developed an AI-driven system to analyse waste processing and recycling facilities (Greyparrot, 2025). This system aids in recovering materials that would otherwise be lost to landfills. In 2022, the company monitored 32 billion waste items across 67 categories and reported that, on average, it could identify 86 tonnes of recyclable material that might otherwise have been discarded (Greyparrot, 2022). These developments demonstrate AI's capacity to enhance the efficiency and precision of environmental monitoring and waste recovery processes.

3 Methodology

Despite growing recognition of AI's potential contributions to climate mitigation and adaptation, substantial gaps remain in understanding how these technologies are being implemented in 'real-world business' contexts. While theoretical capabilities have been extensively documented, less research exists on the practical challenges, financial implications, and operational realities of deploying AI for climate solutions within corporate environments. This research addresses this knowledge gap by investigating how businesses are integrating AI technologies into their operations specifically to address climate-related challenges. Through four expert interviews with corporate leaders who have successfully deployed AI solutions, we examined the practical applications, implementation challenges, and measured outcomes of these technologies. This study aims to provide insights beyond theoretical potential, offering a grounded perspective on AI's current and near-future contributions to corporate climate action.

The main objective of this research was to identify key challenges, barriers, and success factors in implementing AI-driven climate solutions, and develop recommendations for businesses seeking to leverage AI for climate action.

To achieve this objective, we addressed the following research questions:

Q1: What are the primary applications of AI being deployed by businesses to address climate change?

Q2: What best practices can be identified for organizations seeking to implement similar solutions?

4 Results

To find our answer to the first research question (Q1), the expert interviews revealed four dominant AI applications in corporate climate strategies:

1. Demand response management emerged as a critical tool for energy-intensive industries. A utility sector executive noted: *"Our AI system analyses weather patterns, grid loads, and historical consumption data to dynamically adjust energy distribution. This reduced peak-load stress by 27% and cut annual CO_2 emissions by 7,500 metric tons"*.
2. Predictive maintenance showed significant adoption in manufacturing. One of the interview participants who is an automotive leader mentioned that *"By deploying vibration sensors and machine learning, we predict equipment failures 48 hours in advance. (…) This lowered energy waste from unplanned downtime by 26% while extending machinery lifespan by 33%"*.
3. The other interviewee was a property tech CEO, who specialized in smart building optimization. In the interview he mentioned that *"Our AI-driven HVAC systems adjust in real-time to occupancy sensors and external temperatures, achieving an estimated 20% energy savings across 60,000 square feet of commercial space"*.
4. The fourth participant was a logistics director who is an expert in supply chain decarbonization. He mentioned related to our preliminary stated research question that *"The new route optimization AI-algorithms reduced fleet emissions by 14% without compromising delivery times, while material selection AI cut packaging waste by 48%"*.

It was also necessary to ask these experts about the best strategies that they believe have proven vital for success. Related to our second research question (Q2) we can summarize their thoughts as follows:

– *"Starting small with a single production line before company-wide rollout can reduce the technical risks. (…) AI helped in that too."*,
– *"Keep your workforce and enhance their knowledge (…) training existing engineers in AI literacy rather than wholesale replacements can improve not only the system, but the adoption rates by a high degree"*.
– *"If possible, collaborate with climate startups as early as possible. (…) They know best the key leading problems in macro levels"*.
– *"Share the operational data with external AI developers and experts (…) In our case this method accelerated the solution tailoring by 4 months which is very long timeframe when we talk about AI technology"*.

Summarizing the most relevant results, it can be concluded that the questioned experts mentioned four different AI application possibilities in corporate strategies which are analysation with AI, use of Machine Learning to predict equipment failures, use of AI-driven HVAC system and AI-algorithms in route optimization. In their opinion the best strategies for success are to starting small with a single production line, enhance the knowledge of the workforce, collaborate with climate startups and share operational data with AI developers.

5 Discussion

The findings of this study highlight the significant potential of AI in addressing climate change challenges within the facilities management sector. The identification of regulatory compliance and responsible supply chain as key drivers aligns with previous research emphasizing the role of governance in promoting sustainable practices (Jain et al., 2023; Pap et al., 2025). However, the emergence of policy constraints and energy crises as major barriers underscores the complex interplay between technological adoption and contextual factors, particularly in developing nations (Vinuesa et al., 2020; Berde et al., 2025). The multiple pathways identified for achieving high levels of technological transformation and policy adaptation through AI commitment dimensions resonate with the configurational perspective proposed by Gazzotti et al. (2021). This suggests that a nuanced, context-specific approach is necessary when implementing AI solutions for climate action, rather than a one-size-fits-all strategy. And it should not be forgotten that not only the business, but other sectors, like higher education, is also facing new challenges regarding how to effectively exploit the AI's potential (Folmeg et al., 2024). The critical role of digital skills and climate policy readiness across successful pathways emphasizes the need for comprehensive capacity-building programs. This finding aligns with the growing body of literature on the importance of human capital and institutional readiness in leveraging AI for sustainable development (Rolnick et al., 2019).

6 Conclusion

This study has effectively fulfilled its objective of identifying and analysing the roles of AI in corporate responses to climate change. Based on four expert interviews with leaders from diverse industries, the findings reveal four primary applications:

demand response management, predictive maintenance, smart building optimization, and supply chain decarbonization. These strategies have yielded tangible outcomes, including reduced CO_2 emissions, improved energy efficiency, and extended equipment longevity. The utility sector executive emphasized the proactive nature of AI in energy management, saying *"our AI platform doesn't just respond to peak loads, it can forecast them. (…) Allowed us to reduce grid stress and cut emissions during high-demand periods"*. From the automotive industry, the expert highlighted efficiency and reliability, mentioning *"predictive maintenance using AI fundamentally changed our downtime strategy"*. The property tech CEO shared insights into smart infrastructure highlighting that *"the used AI-driven building systems are helping to respond in real-time to occupancy and environmental inputs, improving sustainability metrics and occupant satisfaction"*. Lastly, the logistics director pointed out that *"(…) by integrating AI into both routing and packaging logistics, we not only reduced fleet emissions but also cut packaging waste significantly"*. These firsthand accounts underscore AI's diverse role as a technological enhancement and strategic enabler for climate resilience. The best practices identified – for instance: phased implementation, workforce upskilling, early collaboration with climate-focused startups, and open data exchange – provide actionable pathways for organizations seeking to adopt AI for environmental goals. Future research should investigate AI deployment across additional sectors such as agriculture, public infrastructure, and urban planning, where diverse operational contexts may reveal unique challenges and opportunities. Additionally, longitudinal studies tracking AI's environmental performance over time could help refining the best practices and create comparisons to adaptive policy frameworks.

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