Summary of Potential of artificial intelligence in reducing energy and carbon emissions of commercial buildings at scale

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Introduction

Summary by Ray Marange Climate change is accelerating, and buildings are a major contributor, responsible for 39% of U.S. primary energy use. With urbanization surging and building stock/demand expected to double by 2060, improving building efficiency is no longer optional but urgent. While AI has transformed industries such as healthcare and finance, its potential in building energy efficiency remains underexplored. AI demonstrates significant potential to reduce costs, enhance benefits, and improve safety across the building lifecycle. This study [1] investigates how AI can reduce energy consumption and carbon emissions in medium-sized office buildings, offering a scalable framework that could be applied globally. We will explore four key areas: **Results**, **Discussion**, **Methods**, and **Takeaways & Reflections**. The study focuses on medium-sized offices, and the results can be extrapolated to offices of any size.

AI's impact on energy and emission reductions

Summary by Dwayne Mark Acosta

AI's reduces emissions of buildings

Summary by David Franz

Primary focus of modeling

The paper focuses on two ways that AI can reduce the emissions of buildings.

1) By helping scale up the technologies and speed adoption by reducing the construction and labor costs;
2) By helping reduce emissions in ongoing maintenance and any new construction over the entire building's lifetime.

Scenarios simulated

The paper uses the results gained from the previous section to **simulate six scenarios**. The data is used to estimate parameters for use with complex simulation software to attempt to model the potential lifetime impact on emissions.

1) Frozen with current building efficiency;
2) BAU without AI;
3) BAU with AI;
4) Three policy-driven scenarios promoting high-efficiency energy buildings and net-zero energy buildings, and other policy implementation to achieve zero emissions by 2050.

Scenario	Energy Use (kWh/m^2)	CO_2 Emissions (kg/m^2)
Baseline	200	50
AI Optimized	150	30

TABLE I
Energy use and CO_2 emissions for different scenarios.

Simulation results

The results of the simulation are shown below.

Table I shows the energy use and CO_2 emissions for different scenarios.

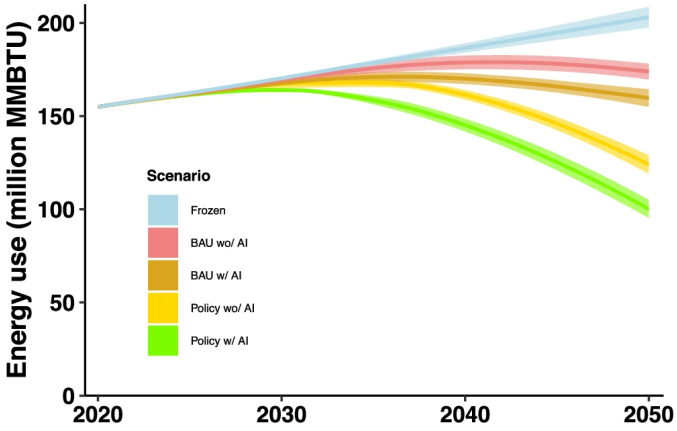

Fig. 1. Different energy use scenarios.

Key insight

"The scenario with AI leads to a higher market share of HEEBs and NZEBs over time compared with the scenario

without AI. This trend continues until the market share of net NZEBs reaches its maximum share."

The paper asserts that using AI in the ways that they propose always leads to a higher market share of efficient buildings.

Thoughts on result

The paper examines various scenarios with some amount of estimation for unknowns, so each individual simulation is unlikely to be exactly right. However, the fact that all scenarios trend in a downward direction for energy use and CO_2 emissions suggest it is highly likely that AI would have some impact on building emissions, but the current lack of data leading to necessary estimation means that the current degree of this impact is still unclear.

DISCUSSION

Summary by Mohamed Amine Benaziza

METHODS

Summary by James Thompson

REFERENCES

[1] C. Ding, J. Ke, M. Levine, and N. Zhou, "Potential of artificial intelligence in reducing energy and carbon emissions of commercial buildings at scale," *Nature Communications*, vol. 15, no. 1, p. 5916, Jul. 2024.

APPENDIX