TITLE**: Can AI Save More Energy Than It Consumes? Singapore's Cooling Experiments**

It has been four years since the Artificial Intelligence (AI) boom took our world by storm, allowing us to achieve tasks at scales that were impossible before. However, this has also come with concerns surrounding energy consumption and how it will shape our world in the future. Currently, people are using AI on a daily basis for a multitude of tasks (See Fig. 1). The adoption of AI in our daily lives has already seen countless benefits: automating repetitive tasks, higher and faster insights from data, enhanced decision-making, 24x7 availability, etc. (Stryker and Kavlakoglu). As demand for this technology increases, the amount of electricity required to train and run these models also increases, leaving us with an uncomfortable question: can a technology that consumes energy on such a scale also help us consume less of it? Singapore suggests it can. Air conditioning is a major source of energy consumption and carbon emissions worldwide (Ritchie), and in a tropical climate it runs almost without pause. Singapore is now applying AI to optimise how that cooling is delivered, aiming to cut carbon emissions in the long run.



Fig. 1: How people are using generative AI in 2026 (Zao-Sanders).

Before looking at how that works, it helps to be clear on what AI actually is. According to an article by Google Cloud, “AI is a field of computer science focused on creating smart machines that can perform tasks that typically require human intelligence, like learning, reasoning, and problem-solving.” AI works by learning from large amounts of data, identifying patterns to make decisions or predictions without explicitly being told how every scenario will play out. As the article put it, “Think of it as teaching a computer by showing it a million examples instead of writing a million rules.”

There are three main forms of AI: Predictive, Generative, and Agentic AI. Predictive AI models use statistical analysis to identify patterns, anticipate behaviors, and forecast upcoming events based on its training data (Mucci). Generative AI takes that a step further. Beyond creating predictions, the model can now create content like images, videos, essays, etc (McKinsey & Company). The best example of this is ChatGPT. Lastly, rather than producing an answer and stopping, Agentic AI models decide for themselves what to do next – much like humans. Consider planning a holiday. A generative model can draft the itinerary, but an agentic one can then compare flights, fill in the booking form, and confirm the seats, checking in with you only at the points that matter. The same applies to sorting through an inbox or filing a report (Stackpole).

All three forms run on the same foundation. These models are mainly trained and deployed in data centers, “facilities used to house servers, storage systems, networking equipment and associated components that are installed in racks and organised into rows (IEA).” You can read more about the specifications of data centers here. According to the International Energy Agency (IEA), by 2030, the electricity consumption by data centers around the world is estimated to reach around 945 TWh, representing just under 3% of total global electricity consumption in 2030 (See Fig. 2).

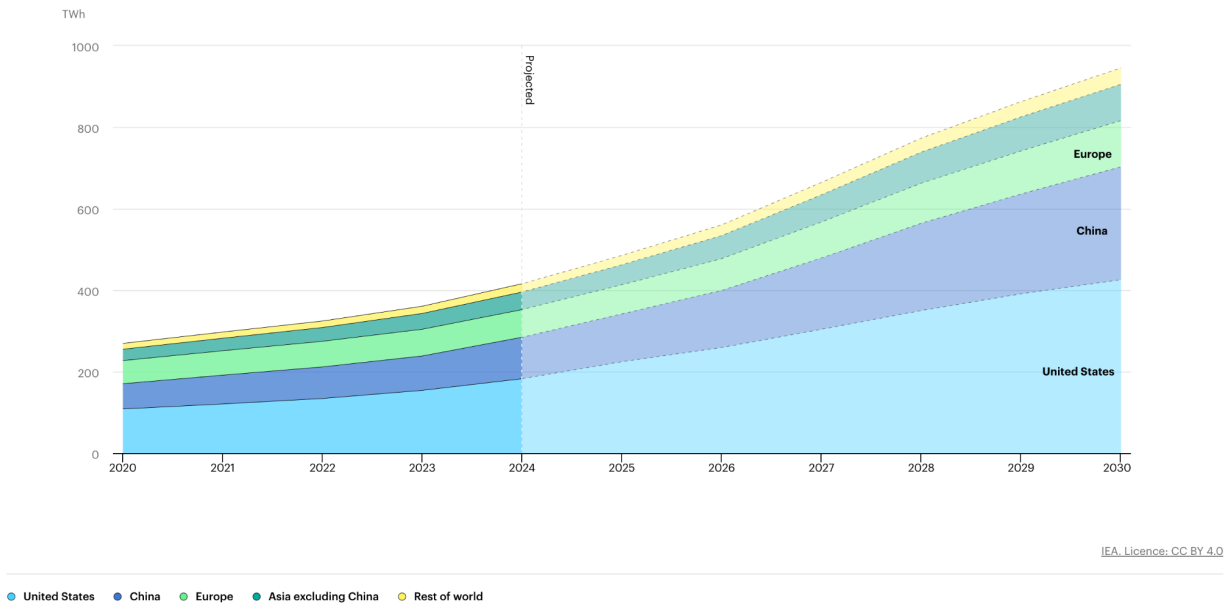


Fig. 2: Data centre electricity consumption by region (IEA).

In a city right on the equator, the biggest consumption of electricity is not computing but cooling. In Singapore, air conditioning accounts for roughly 24 percent of the average household's electricity consumption (Liu et al.). Along with this, the article stated that “99 per cent of private residences are equipped with air-conditioners, as are the majority of public housing units.” Further, The National Environment Agency estimated that around half of the electricity used in buildings around the city went to cooling as early as 2010.

The consequences of such dependence reach well beyond just the monthly bill, however. A UN report warns that without major changes, 10 per cent of all greenhouse gas emissions will come from cooling by 2050. While some of that comes from the electricity itself, refrigerants also create a considerable impact. Hydrofluorocarbons, the synthetic gases inside most existing air conditioners, trap far more heat than carbon dioxide and “emissions of these syntactic gases mainly occur when equipment is leaking, for example due to incorrect maintenance or disposal (Doorduin).” In a country where switching the air conditioning off is growing increasingly difficult, optimization must become a priority.

One clear example of this work is research led by Christopher Lee at Nanyang Technological University and Taesu Cheong at Korea University. They are aiming to develop net-zero energy buildings through AI-based Heating, Ventilation, and Air Conditioning (HVAC) system control. They recognized that optimizing the use of HVAC systems is one of the most cost-effective solutions that not only improves building energy efficiency, but also reduces building energy consumption (AI Singapore).

Traditional methods of controlling HVAC systems are typically limited by manual labour and expert knowledge. For these reasons, it is extremely difficult to maintain the optimal use of the systems as conditions shift. Some solutions included rule-based systems, model-based and data-driven systems, and expensive airflow prediction methods; however, each of these solutions had their own drawbacks. Because every chiller configuration is different, rule-based systems require custom rules to be built for each building, and even then, performance generally falls short of what is achievable. Model-based and data-driven alternatives require highly accurate building models and clean, complete sensor data, neither of which real buildings reliably provide. Methods that predict airflow using computational fluid dynamics are accurate but computationally expensive, which limits how often they can realistically be run (AI Singapore).

This project takes a different route. Rather than simulating the physics of airflow, it predicts indoor air conditions from operational data alone, skipping the heavy computation entirely. Control decisions are then handled by deep reinforcement learning, which lets the system work out its own strategy by learning from the building's interconnected conditions, instead of following instructions written in advance. It also optimises for several things at once: temperature, humidity, energy consumption, and particulate matter are treated as a single control problem. Through this research, the system will also be able to account for uncertainty from measurement errors or situations it has never encountered. Finally, the proposed transfer learning approach will allow the knowledge of one agent in an individual space to go to another agent in a similar space or system, allowing for coordinated cooling (AI Singapore).

Beyond research, companies like SP Group have already constructed buildings that employ AI to optimize cooling. SP Group is a leading utilities provider in Asia Pacific and aims to empower the future of energy through low-carbon, smart solutions (SP Group). They led the development of Labrador Tower in Singapore, a building that "is expected to be about 50 per cent more energy-efficient than a conventional air-con system (Rashiwala)." The article also stated that the energy savings come from three main systems working together: underground thermal energy storage, a microclimate control system, and hybrid active chilled beams.

The system that uses AI is the microclimate control system. This system uses SP Group's Green Energy Tech, a self-learning building intelligence platform that combines AI with Internet of Things sensors to regulate air conditioning across the tower. Its predictions draw on inputs such as the number of people in the building and the weather outside, then works with sensors and smart dampers to direct airflow where it is actually needed rather than cooling the whole floor evenly regardless of use (Rashiwala; Labrador Tower). Similar to Agentic AI models, instead of just predicting what the ideal temperature is and where energy should be allocated (like generative models), the AI system in Labrador Tower actually controls the cooling systems to optimize its usage. You can learn more about the underground thermal energy storage system and hybrid active chilled beams from the article by Kalpana Rashiwala cited below.

So, can AI, the technology that uses so much energy, help us use less? For now, the answer is unclear. Data centre demand continues to climb toward that 945 TWh figure, but at the same time, projects run by SP Group and the Singaporean government are targeting one of our largest sources of carbon emissions and energy use. Cooling is also only the starting point. A system that can optimize our use of air conditioners can also be taught how to better control lighting, water heating/cooling, and any other ways buildings use energy, which means the savings potential is much larger than air conditioning alone.

The worry that AI's demand for electricity will keep growing until it becomes unsustainable is reasonable. What projects such as those in Singapore offer is a chance to see whether AI can also help us cut out energy usage, and, maybe even come out net positive.

Works Cited

AI Singapore. "Development of NetZero BEMS through AI-Based HVAC System Control." *AI Singapore*, https://aisingapore.org/development-of-netzero-bems-through-ai-based-hvac-system-control/.

Doorduin, Janet. "Air Conditioners Worsen Global Warming. What Can We Do?" *Earth.Org*, 17 Sept. 2025, https://earth.org/air-conditioners-worsen-global-warming-what-can-we-do/.

Google Cloud. "What Is Artificial Intelligence (AI)?" *Google Cloud*, Google, 2025, https://cloud.google.com/learn/what-is-artificial-intelligence.

IEA. "Energy Demand From AI" *IEA*, 2025, https://www.iea.org/reports/energy-and-ai/energy-demand-from-ai.

Rashiwala, Kalpana. "Labrador Tower Set to Showcase SP Group's Green, Digital Energy Prowess." *The Business Times*, 15 Sept. 2023, https://www.businesstimes.com.sg/property/commercial-industrial/labrador-tower-set-showcase-sp-groups-green-digital-energy-prowess.

Labrador Tower. "Sustainability : Labrador Tower." *labradortower.com.sg*, 2026, https://labradortower.com.sg/sustainability/.

Liu, Ziwen, et al. "Commentary: Singaporeans' Reliance on Air-Cons Will Only Lead to More Discomfort." *CNA*, 5 Apr. 2024, https://www.channelnewsasia.com/commentary/singapore-heat-hot-weather-aircon-home-office-consumption-4242321.

McKinsey & Company. "What Is Generative AI?" *McKinsey & Company*, McKinsey & Company, 2 Apr. 2024, https://www.mckinsey.com/featured-insights/mckinsey-explainers/what-is-generative-ai.

Mucci, Tim. “What Is Predictive AI?” *IBM*, 12 Aug. 2024, https://www.ibm.com/think/topics/predictive-ai.

National Environment Agency. “Singapore’s Second National Communication .” *National Environment Agency (NEA)*, Nov. 2010, https://www.nea.gov.sg/docs/default-source/cmd-documents/climate-change/second-nc_12-nov-2010.pdf.

Ritchie, Hannah. "Air Conditioning Causes around 3% of Greenhouse Gas Emissions. How Will This Change in the Future?" *Our World in Data*, 29 July 2024, ourworldindata.org/air-conditioning-causes-around-greenhouse-gas-emissions-will-change-future.

SP Group. “Corporate Profile.” *spgroup.com.sg*, https://www.spgroup.com.sg/about-us/corporate-profile.

Stackpole, Beth. “Agentic AI, Explained” *MIT Sloan*, 2026, https://mitsloan.mit.edu/ideas-made-to-matter/agentic-ai-explained.

Stryker, Cole, and Eda Kavlakoglu. “What Is Artificial Intelligence (AI)?” *IBM*, 9 Aug. 2024, https://www.ibm.com/think/topics/artificial-intelligence.

United Nations Environment Programme. “Boiling Hot: How Countries Can Beat the Growing Threat of Extreme Heat.” *UNEP*, 25 July 2025, https://www.unep.org/news-and-stories/story/boiling-hot-how-countries-can-beat-growing-threat-extreme-heat.

Zao-Sanders, Marc. “How People Are Really Using AI In 2026.” *Harvard Business Review*, June 2026, https://hbr.org/2026/06/how-people-are-really-using-ai-in-2026.