Issue Paper

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Artificial Intelligence: A Troubling Ecological Problem

As of 2025, datacenters consume 1.5% of global electricity, a figure projected to double or triple by 2030, driven largely by interest in generative AI. This comes largely out of a need to sustain the booming tech trends enabled by companies like OpenAI and Nvidia, but is also being fueled by a global race to build better AI models before “someone else” does. And, while datacenters are built all over the world as long as there is cheap land and good connectivity, this is an especially pressing issue in the United States, where these trends, combined with demands of national security set forth by the current administration, have cemented a trend in building cheap, local computing infrastructure, putting strain on aging utilities infrastructure and entrenching the cheapest available energy production sources.

The rate of growth needed to press forward in the AI race is rather jaw-dropping. Karen Hao’s article in the Atlantic reported that Microsoft, one of many tech giants furiously building datacenters (primarily for OpenAI) is spending 10 billion per quarter in this pursuit, with plans to construct 50 to 100 datacenters per year. This massive expansion reflects the broader AI boom driving unprecedented demand for computing infrastructure across the tech industry. Companies like Google, Amazon, and Meta are similarly racing to build the computational capacity needed for AI model training and cloud services.

While this may be exciting to those interested in AI, this trend contrasts sharply with companies' long-standing pledges to be carbon negative in the next decade, and threatens water supplies in drought-stricken regions. in Ingrid Burrington’s article in The Atlantic from 2015,

noted that datacenters typically drew power from the grid and could leverage their influence for greener solutions. However, the recent effort to build more datacenters during the current AI boom has driven tech companies instead to the most affordable option in order to meet demand. Recent U.S. regulations, including the 'Big Beautiful Bill' mandate quarterly oil and gas sales while providing substantial tax cuts for fossil fuels. Beyond electrical grid concerns, datacenter construction strains water resources, strain on water utilities is already expected, with the Karen Hao's article projecting the use of evaporative cooling to "reach more than 50 million gallons every year." This compounds drought issues, particularly in drought stricken regions like Arizona, where cheap land has made it a hotspot for datacenter construction, sometimes leaving local towns without drinking water for extended periods.

Throughout my undergrad, I have been primarily involved in research with Dr. Dmitry Ovchinnikov's group, focusing on the fabrication and characterization of nanodevices incorporating two-dimensional (2D) van der Waals (vdW) materials for memory and logic applications. The fundamental goal of these efforts is to learn how to control the properties of 2D quantum materials and to harness them in novel device architectures, which generally fall into computer memory and storage applications. I had been aware of the importance of this research in a shallow sense, but my focus has been concentrated largely on the science, as opposed to the application of these devices. Therefore, the opportunity to understand where the resources behind datacenters come from, and how current economic and political trends aim to grow this further matters a lot to me.

At least in the United States, there are two driving factors to this: political and economic. On the one hand, the political climate in the United States is aimed at discrediting green solutions at a federal level, and on the other, the Economist puts it best, "Something like a sixth

of the 2% rise in American real GDP over the past year has come from investments in computer and communications equipment, including chips, and data centres. Add in the grid upgrades to power AI models, plus the intellectual-property value of the software itself, and one estimate puts the boom's contribution to real GDP growth at 40%." It is clear that, as things are, nobody wants to slow down computing infrastructure growth, lest interest die down overnight, in turn reinforcing the ecological concerns associated with the American power grid. It's clear then, that the next best thing that can be done is to roll out technologies that improve things at the datacenter level. Magnetoresistance random access memory (MRAM) technology is, as of the last few years entering commercial production, and could play a tremendous role in bringing energy cost down while simultaneously reducing cooling requirements due to the elimination of joule heating. It is for this reason that I wish to explore such hardware improvements which are a plausible step forward in addressing ecological concerns.