TWO OPPOSING IMPACTS OF AI ON ELECTRICITY

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Before reviewing the two opposing impacts of AI on electricity, it is important to remember the critical role that energy plays in climate change. In Canada, fully 81% of the anthropogenic greenhouse gas (GHG) emission are from the production and use of energy [1]. To address this existential challenge, Canada and other countries have set net zero GHG emission targets which will require both a switch away from burning fossil fuels as well as reducing the amount of energy we waste, currently about 67% [2].

Interestingly, AI will have two opposing impacts on the demand for electricity. One will be an increase in demand for electricity to power the AI data centres and the other will be reducing the demand for electricity by using AI to improve the overall efficiency of the electricity system.

Due to the major shift that will have to be made from burning fossil fuel to using non-GHG emitting electricity, Ontario's demand for electricity is projected to increase by 75% by 2050 [3]. Part of this increase is due AI data centres which use about 10x more electricity than conventional searches to run the computers and cool the buildings surrounding them [4]. By 2050, it is estimated that data centres will be responsible for about 4% by 2035 [3].

Like the famous 3 R waste management paradigm, the first think that should be done is to reduce the demand for electricity in these new data centres. A recent report from MIT Sloan[5] estimated savings of 10-20% can be made using the following approaches:

- Limit power requirements – Examples from this study include more efficient hardware, power capping (limiting the amount of power feeding the processes. Other studies have recommended water cooling as a means to reduce electricity requirements
- Rethink model training – this includes using cheaper, less-robust AI models for training.
- Make software AI and carbon aware – This includes running AI workloads that aren't time sensitive at times when the grid is cleaner. This is a form of Demand Response.

The next step to reduce the carbon footprint of AI would be to use electricity from non carbon emitting sources. This can be done through direct ownership of the clean generation station or purchasing carbon free electricity from another generator.

While the impact of AI on the demand for electricity has been estimated by many organizations, there has been much less on the impact of using AI to improve the efficiency of the entire electricity system. The US Department of Energy, among others, have noted that AI could improve grid planning, enhance grid resilience and help discover new materials such as batteries, solar-active materials and improved caalysts[6,7]. Another US DOE report estimates that AI and other improvements to the country's existing grid could result in savings of as much as 100 GW which is 13% of current US peak demand[8].

One of the few reports that puts any estimates of the potential savings from using AI is from a US patent firm who provided the following estimates, most with the note that savings could be "up to..."[9]:

- distribution system losses – up to 30% reduction
- grid downtime – reduced by up to 50%
- energy efficiency – improved by up to 20%
- demand forecasting – improved by 40-60%
- blackout risks – reduced by up to 55%
- operating costs – reduced by up to 25%
- energy storage – improved by up to 35%
- repair time – cut by up to 60%
- cyber attack risks – reduced by up to 75%

Much more work needs to be done to better quantify the potential benefits to improving the electricity system using AI. Until more work is done on the savings side, it will be hard to comment on the net impacts of AI on the electricity system. But until then, it would seem at least possible that the potential savings will as large or even larger than the estimated additional demand.margin.

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