

Singapore's AI ambitions must make each megawatt work harder

By Lee Poh Seng

ARTIFICIAL intelligence is often discussed as a digital revolution. But every AI service ultimately depends on physical infrastructure: chips, power systems, cooling equipment, networks and electricity.

For Singapore, this matters because power, land, water and grid capacity are constrained. The issue is not only how much electricity AI data centres will use, but also how quickly high-energy-demand facilities can come online compared with the time needed to expand electricity infrastructure.

The Energy Market Authority (EMA) expects Singapore's peak electricity demand to grow by 2.9 to 6.5 per cent annually over the next decade, with data centres and semiconductor manufacturing among the drivers.

A reliable, diversified and renewable energy supply remains essential. But Singapore should also plan its power grid and the energy-demanding infrastructure as one connected system.

Beyond power usage effectiveness

Singapore's second "Data Centre – Call for Application", which was launched in December 2025, requires new projects to achieve a power usage effectiveness (PUE) of 1.25 or better at full IT load, adopt best-in-class IT energy-efficiency standards and source at least half their electricity from eligible green-energy pathways.

PUE measures the ratio of a data centre's total energy use to that of its IT equipment. A PUE of 1.25 means servers using one unit of electricity need another 0.25 unit for cooling and other services.

A 2026 survey by the Uptime Institute

showed a global industry average annual PUE of 1.52, holding steady from 2025 due to legacy infrastructure, even as high-density AI deployments accelerate. But this measured average is not directly comparable with Singapore's full-load target.

PUE is useful but limited. It tells us how much additional energy a data centre consumes beyond its IT equipment. It does not tell us how effectively that IT electricity is turned into useful computing.

For Singapore, the more important question is how much useful compute and economic value can be obtained from each constrained megawatt while managing carbon emissions, water consumption and reliability.

Other measures include useful computing output per kilowatt-hour (kWh), how fully AI chips are used, water consumed per unit of IT electricity and associated carbon emissions.

The Digital Infrastructure Bill, passed in October, provides for sustainability licensing of data centres with at least 3 megawatts (MW) of critical IT load. By extending the regulatory framework to new and existing facilities, it reinforces the importance of improving the performance of Singapore's existing data centres, not only building more efficient new ones.

Cooling efficiency is key

Improving computing efficiency requires looking at the whole chain: chip efficiency, processor utilisation, software, power conversion, cooling and workload scheduling.

Cooling is becoming especially important. A rack of AI servers can draw more than 100 kilowatts (kW). At a steady 100 kW, that is 2,400 kWh per day or 72,000 kWh over 30 days – equivalent to the

monthly use of about 270 three-room public housing flats, assuming 267 kWh each.

Actual consumption varies.

Air cooling at such densities is difficult; liquid cooling removes heat closer to processors and may reduce cooling energy while enabling higher computing density.

Singapore's national benchmark SS 726:2026 is therefore timely. Launched in August, it is the world's first standard specifically for liquid cooling in tropical data centres, covering design, commissioning, operation and maintenance.

But liquid cooling does not make heat disappear. The heat must still be rejected outdoors, and lowering electricity consumption by using substantially more water is not necessarily a good trade-off for Singapore. Energy and water need to be optimised together.

By reducing cooling energy consumption and improving accelerator utilisation, data centres can deliver more useful computing output from the same power capacity, potentially supporting greater economic value without a proportional increase in electricity demand.

Make large loads smarter

Singapore's demand-response and interruptible-load capacity grew from 71 MW in 2022 to 192 MW by June 2025. Under these programmes, participating large power users can temporarily reduce electricity demand when the system needs support, easing strain on the grid.

Data centres could contribute further, but expectations should be realistic. AI accelerators, including expensive graphics processing units used for AI computing, cannot simply be switched off whenever electricity demand peaks.

More practical opportunities may lie in batteries, uninterruptible power supplies, cooling systems and deprioritising tasks.

For instance, Google has shifted non-urgent data-centre computing to times when the grid is stressed. Microsoft has demonstrated how backup batteries at its Dublin data centre can support grid stability.

In Singapore, SP Group uses thermal storage in Marina Bay to reduce cooling-related electricity demand during peaks.

Notably, such measures must preserve critical services.

A data centre that can briefly reduce grid demand, draw on stored energy, or shift suitable workloads can provide flexibility without compromising critical services. The goal is not to turn data centres into power stations, but to make better use of their existing assets and controllable loads.

Test before scaling

But theoretical discussions do not necessarily translate into real-life results. Component performance is not system performance.

Liquid-cooling systems, batteries and power converters may perform well in a laboratory, but may behave differently when combined with real processors, pumps, controls and tropical heat rejection.

That is why live test beds and brown-field demonstrations matter. The Sustainable Tropical Data Centre Testbed at the National University of Singapore allows cooling, power and control technologies to be evaluated as integrated systems under real operating conditions.

Such testing is especially relevant to Singapore and neighbouring South-east

Asian markets, where high temperatures and humidity complicate cooling and energy efficiency.

Lessons from tropical test beds can help operators evaluate what works locally before committing to costly infrastructure upgrades.

Standards tell us what good performance should look like. Test beds show whether it can be delivered before expensive infrastructure choices are locked in.

Raise the better question

Asking if Singapore can generate enough electricity for AI is too narrow.

The better question is whether every additional megawatt used by AI can create sufficient economic and strategic value while preserving reliability, affordability, resilience and Singapore's path to net zero.

If Singapore can co-design power and compute, plan generation alongside demand, and devise computing, cooling and control systems together, AI need not simply become another load that the energy system must chase.

It can instead become a catalyst for a more resilient, efficient and intelligent energy system.

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The commentary is based on the writer's own experiences, observations and argument. AI tools were used for drafting and editing. The writer remains fully accountable for the commentary's accuracy, originality and final form.