DATA CENTRES

Sharing the load

A look into how the projected expansion of AI infrastructure could strengthen Ontario's energy systems.

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MaRS

Mantle Climate

Executive summary

Artificial intelligence (AI) data centres are quickly becoming core economic infrastructure — they are as fundamental to competitiveness as transportation networks and energy grids. Reliable access to secure, low-latency AI compute power is necessary for innovation and productivity across sectors, including advanced manufacturing, transportation, healthcare and research. Jurisdictions without this key infrastructure risk losing talent, investment and scientific leadership to regions with more robust resources.

Building domestic AI compute capacity also strengthens data security and sovereignty, attracts new investment and supports high-quality employment across construction, skilled trades, power systems, cooling and networking technologies and ongoing operations. These projects create local supply-chain demand and contribute significant long-term tax revenues.

AI data centres, however, are one of the most electricity-intensive forms of development the world has seen. Meeting projected demand for AI training and inference will require thousands of megawatts of new, continuous load over the next decade and beyond. At the same time, Ontario is electrifying transportation, heating and industrial processes. Without coordinated planning and energy innovation, data centre growth could strain system capacity, drive up costs and complicate Ontario's greenhouse gas (GHG) emissions trajectory, with implications for reliability and affordability.

Ontario faces a strategic allocation challenge: How can the province best direct limited, high-value electricity capacity toward projects that maximize economic output, resilience and public benefit? With a proactive approach, this could be an opportunity to harness a critical wave of infrastructure investment to build a more resilient and sustainable energy system while delivering robust sovereign compute power.

MaRS Discovery District and Mantle Climate launched the Future of Data Centres in the Greater Toronto Hamilton Area (GTHA) and Ontario initiative to explore this opportunity. Bringing together key stakeholders, the project aimed to investigate realistic data centre growth trajectories over the next decade, quantify their system-level impacts and identify solutions that could mitigate those impacts. Through research, high-level modelling, stakeholder engagement and scenario analysis, we estimate that Ontario could reach 1.5 gigawatts of new data centre load by 2035, with high-growth scenarios approaching 3 gigawatts. Even under baseline growth, this expansion would materially increase annual electricity demand, peak load and electricity-related emissions — particularly in the GTHA, where most cloud and AI inference providers are likely to be based.

Despite these pressures, participants agree that system and emissions impacts can be significantly mitigated through the coordinated deployment of such measures as demand response, waste heat recovery, energy storage, clean power purchase agreements (PPAs) and low-carbon construction. Notably, in the high-growth scenario, on-site power generation, likely from natural gas, would also need to play a major role.

A central finding is the need for co-located, purpose-built infrastructure or community hubs that align siting, permitting and energy infrastructure from the outset. These hubs can unlock additional energy capacity, reduce community impacts, support energy reuse and create efficiencies that individual projects cannot achieve. Such collaborative developments are seen in other jurisdictions but have yet to be applied at scale in Ontario.

Based on scenario findings and cross-sector input, we have identified several opportunities for Ontario to manage data centre growth responsibly and sustainably:

1. **Clarify Ontario's strategic stance**: The province needs to determine its priorities for sovereign compute power, research capacity and digital-economy competitiveness.

2. **Leverage policy tools**: Use Bill 40, Integrated Energy Plan Energy for Generations and other policy tools to fast-track initiatives that deliver economic, sovereignty and community benefits while supporting a reliable, affordable and clean system.

3. **Prioritize key projects**: Allocate grid access and streamline permitting processes for projects that demonstrate strong value per megawatt, including availability of on-site generation, demand response, waste heat utilization, efficiency and sustainable construction, while screening out speculative or low-value load.

4. **Improve coordination**: Build predictable and timely pathways for sustainable development across provincial, municipal and utility approvals.

5. **Foster collaboration**: Establish a provincial forum or mechanism to enable co-located infrastructure planning and cross-sector initiatives.

6. **Develop a sustainable pilot**: Create a co-located data centre development to test out mitigation solutions, governance models and permitting approaches.

Decisions made in the next three to five years — well before major new clean generation projects come online — will determine whether AI infrastructure growth strengthens or strains Ontario's energy systems and communities. This report provides an analytical foundation and cross-sector insights to support the province's emerging digital infrastructure strategy.

"Canada's future security and economic competitiveness will require robust, clean energy systems and significant sovereign AI infrastructure. Currently, those two requirements seem to be at odds. The near-term challenge is also the opportunity: to collaborate and innovate to build sustainable digital infrastructure that strengthens the energy system rather than straining it."

Kathleen Kauth, COO, Mantle Climate

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Expanding capacity

As AI adoption continues to scale, there is a growing urgency to meet infrastructure demand without sacrificing community needs.

Project overview

Artificial intelligence (AI) data centres are essential economic infrastructure — they have become as important as roads and energy grids. Countries without reliable access to AI infrastructure will fall behind in contributions to basic research and discovery, driving researchers and innovators to work elsewhere. This infrastructure enables productivity and competitiveness across the economy by providing secure, low-latency compute power close to where Canadians live and work. It also safeguards data security and sovereignty, anchors new investments and underwrites high-quality jobs as well as creates local supply-chain demand and strengthens the tax base that funds community services.

At the same time, data centre growth introduces a new category of electricity demand: large, continuous and geographically concentrated loads that are competing for finite system capacity. As Ontario advances electrification across transportation, buildings and industry, decisions about which large loads to prioritize and under what conditions will increasingly shape economic outcomes, system reliability, greenhouse gas (GHG) emissions trajectories and affordability for ratepayers.

Balancing the economic and competitive benefits of digital infrastructure growth with the needs of communities and the energy system is a critical — and complex — task. Success can only be achieved through deep collaboration across several industries and public services.

In response, MaRS Discovery District and Mantle Climate launched the Future of Data Centres in the Greater Toronto Hamilton Area (GTHA) and Ontario project to:

- Determine estimates of economically competitive compute growth in Ontario over the next decade.
- Quantify the local and system-level power, energy and emissions impacts from this growth.
- Explore innovative solutions to reduce those impacts.

This project aimed to kick-start a digital infrastructure ecosystem in Ontario by facilitating collaboration among the energy and digital infrastructure industries, including energy providers, data centre developers, AI users, technology innovators and policy-makers. Overall, 35 interested parties contributed to this research (Appendix A).

The project consisted of three workshops. Each was informed by research conducted by Mantle Climate, which sparked in-person discussions among workshop participants. The results of the workshops and research contributed to a comprehensive understanding of the challenges and opportunities facing Ontario, and specifically the GTHA, where the province's data centre growth predominates. This report synthesizes the findings and recommendations to chart a path forward for sustainable and economically competitive data centre development in the region.

The growing demand for power in the GTHA

Canada ranks fifth globally for data centre density, with more than 330 data centres across the country. The GTHA is a leading Canadian data centre hub for both traditional cloud and enterprise/co-location compute power. This is because Canada's major global digital infrastructure is in downtown Toronto, as are some of Canada's largest businesses. The region also has the country's highest population density. These factors attract the world's biggest cloud companies and co-location providers.

According to CBRE, the Greater Toronto Area had 315 megawatts of total inventory and 153 megawatts under construction as of mid-2025. This is after several years of a 13 percent compound annual growth rate in the area. With the explosion of AI and requisite federal commitment to digital infrastructure investment, those numbers could skyrocket.

The next generation of AI-enabling digital infrastructure will require thousands of megawatts of electricity. The Independent Electricity System Operator (IESO) has reported interest from data centre developers on the order of several gigawatts in Ontario alone. Additionally, the federal government has signalled its goal of increasing AI infrastructure development through both policy documents and funding programs, including Innovation, Science, and Economic Development Canada (ISED)'s $2 billion as part of the 2025 budget's Canadian Sovereign AI Compute Strategy for compute infrastructure and training and development.

BY THE NUMBERS

315 megawatts

The compute capacity of Toronto's total inventory in mid-2025.

5,000 megawatts

Additional province-wide capacity needed in the next decade due to rising demand and expiring supply contracts.

$2 billion

Investment earmarked by the federal government to bolster AI infrastructure.

At the same time, the IESO's 2024 Annual Planning Outlook (APO) already identified a province-wide need for approximately 5,000 megawatts of additional capacity in Ontario in the 2030–2034 time frame, driven by rising demand and the retirement of existing generation. The province is already addressing this through ongoing procurements and investments, including nuclear refurbishment. Significant new electricity demand from data centres would add to these system needs, impact local climate goals, and place additional pressure on generation and transmission infrastructure. This is particularly challenging in Toronto's downtown core, where there are existing power transmission constraints[1]. As such, data centres must be developed as innovatively and sustainably as possible to ensure the GTHA can maintain an adequate electricity supply and meet its climate and AI-dependent economic goals.

[1] The IESO's Annual Planning Outlook reports for 2024 and 2025 both state this challenge in the Greater Toronto Area Bulk Supply section.

What's needed to bolster digital infrastructure and AI industry

AI-driven compute demand is not monolithic: training large models and deploying inference workloads impose fundamentally different technical, economic and locational requirements. Yet these distinctions are often blurred in growth projections, alongside uncertainty around how advances in algorithms, model architectures and system efficiency may reshape the scale and trajectory of future training and inference architectures.

AI training data centres

These centres can be understood as the manufacturers of AI outputs, including such large language models (LLM) as ChatGPT, Claude, Grok and Gemini. LLM training is typically achieved in large GPU clusters in data centres that are significantly more energy-intensive than those of traditional cloud computing. This is driven in part by observed "scaling laws," the idea that training the latest frontier models requires more compute power, and therefore more energy than earlier generations. For example, xAI's Grok 3 was trained on 200,000 GPUs requiring more than 200 megawatts of power. The previous version, Grok 2, was trained on only 8,000 GPUs.

There is, however, considerable uncertainty as to whether the benefits of scaling will continue. Plus, algorithmic innovation will likely start to play a larger role in improving models, rather than simply using more data and compute power. Accordingly, there is similar uncertainty around the pace of investment in AI training–specific infrastructure beyond the next two or three years.

Sovereign AI training capability is widely viewed as an important component of Ontario's long-term economic competitiveness, particularly for attracting and retaining advanced research, talent and AI-driven enterprises. Currently, GPU-based training capacity required for local research and innovation is sparse in Canada.

While local AI training data centres benefit Canadian researchers and innovators, they do not largely impact the ability of Canadians to use AI day to day.

KEY TERMS

Training

The first phase in developing an AI model involves feature selection, data processing and model optimization. The process reinforces examples of desired inputs and outputs in order to train the model. Because it often involves complicated neural network–based algorithms, training requires heavy computational power and large processing capacity.

Inference

At this stage, real-world data is applied to the model so that it can analyze this new information and make predictions. It requires less computational power and typically uses a cloud server or an edge device.

Cloud services and AI inference data centres

These services and centres enable real-time digital services delivered directly to end users across Canada. Cloud services include email, storage (i.e., Google Drive and Microsoft OneDrive), streaming (i.e., YouTube, Netflix and Spotify) and collaboration tools (i.e., Zoom, Teams and Slack). Traditional cloud services have supported these general computing needs, while AI inference delivers the real-time execution of AI models embedded within many of these services. Inference applications leverage AI outputs to service such tools as AI agents, AI voice assistants and chatbots, image and video generators, fraud detection, text editing and autocorrect. Accordingly, it makes sense that new cloud and enterprise infrastructure data centres will integrate inference within their architecture.

Because AI inference is the predominant source of new growth and industry change, we placed a larger focus on it for this project.

While inference workloads do not typically retrain base models in real time, the data generated through user interactions may later inform fine-tuning and model updates. For that reason, the location of where inference occurs has implications for both data and model sovereignty. Many inference applications are also highly sensitive to latency, often requiring responses within milliseconds. Distance matters: approximately every 80 kilometres between a data centre and an end-user adds 1 millisecond of latency. This means that low-latency inference must occur close to end users.

Currently, a single AI inference data centre serves many applications and users in a one-to-many model. For example, a financial institution may use a single fraud-detection model in a centralized inference environment to analyze thousands of credit card transactions every second, generating real-time alerts across millions of customers. It is uncertain whether this model will persist or whether some inference workloads will shift to decentralized, many-to-many computing models. Some applications may eventually execute inference directly on device-level hardware rather than in centralized data centres, such as a door lock whose single purpose is to identify visitors, notify the owner and then delete that information. The extent to which such models scale will have significant implications for predicting future energy demands.

Overall, consumer and enterprise use of generative AI, and even more advanced AI, is still uncertain. But some key building blocks that are already evident include:

1. Hyperscale data centres are already building inference hardware into their cloud sites.
2. If possible, enterprises will want their inference hardware located close to their IT teams and other compute sites.
3. Latency requirements will further limit geographical expansion for such applications as real-time voice, fraud detection, smart city tools, augmented reality and gaming.

Over the long term, inference will likely see a higher capital spend than training, though much of the early spend has been on training in order to get these models off the ground. These factors highlight both the uncertainty and the underlying drivers of AI-related compute demand, underscoring the need for a shared, practical understanding of how AI and data centre growth could realistically develop in Ontario. This project set out to address these challenges by developing informed expectations of the AI infrastructure growth rate Ontario may reasonably plan for.

GROWING SUSTAINABLY

The growth of digital infrastructure to support economically competitive AI development must be balanced with broader growth priorities and the need for resilient and affordable clean energy. Many existing climate targets and mitigation strategies were developed before the recent acceleration in the growth of AI-driven data centres and do not explicitly account for the scale or characteristics of this emerging source of demand.

AI training and AI inference data centres are energy-intensive, with emissions that vary by region, depending on the electricity mix and available capacity. Although Ontario's grid is relatively low-carbon, marginal demand is largely met by natural gas, which has a higher emission factor. When large, continuous loads are served primarily from the grid, they can increase system-wide emissions and contribute to higher coincident peak demand. Where on-site generation is deployed, grid peak impacts may be reduced, but emissions outcomes and local fuel infrastructure requirements must also be considered.

In the near term, these impacts can be managed with strategies and solutions that reduce or shift demand, improve system flexibility and lower emissions intensity, while complementing ongoing investments in renewables, energy storage and nuclear refurbishment.

Data centres also generate embodied emissions from construction, particularly from materials such as concrete, steel and electrical equipment. These emissions occur upfront and can be significant, but they can be reduced through material selection, design decisions and construction practices.

Beyond emissions, the rapid expansion of digital infrastructure introduces new reliability challenges, especially during peak demand. Coordinated mitigation strategies must work in tandem with system-wide investments to ensure digital infrastructure expands in a reliable, affordable and low-carbon way.

Workshop and research findings

To model the growth of compute power in Ontario over the next decade, the project team developed a baseline scenario, measured in megawatts, that reflects the minimum growth that is likely to occur by 2035. This baseline represents a status quo trajectory: reasonable, planned expansion of homegrown infrastructure with no additional policy barriers to data centre development.

The project team also established an aggressive growth scenario. The team then assessed the impacts of each scenario based on three variables:

1. Annual electricity demand
2. Coincident peak load
3. Total operational emissions

The baseline and aggressive growth scenarios were developed through primary and desktop research, high-level modelling, as well as workshop discussions[2]. Consistent with the project's scope and objectives, the goal was not to produce detailed, multi-variable system modelling, but rather to provide robust directional data. Advanced dynamic modelling is identified as a potential next step. Additional methodology details are provided in Appendix B.

Baseline scenario

As of mid-2025, the Greater Toronto Area had 315 megawatts of operational IT capacity for traditional compute power. In the first project workshop, participants agreed that Ontario's data centre industry will likely see baseline growth of approximately 1.5 gigawatts over the next 10 years. This was broken down as follows:

- ~1 gigawatt of traditional cloud/co-location development concentrated in the GTHA, which includes a mix of inference and training capabilities. This growth is a continuation of the 13 percent annual growth rate seen in the GTHA in recent years, rising to 15 percent by the end of the 10-year period.
- 0.5 gigawatt of dedicated AI training projects in Ontario, outside of the GTHA, where land is less constrained.

While AI compute types will increasingly blur, these distinctions support early-stage, defensible scenario modelling.

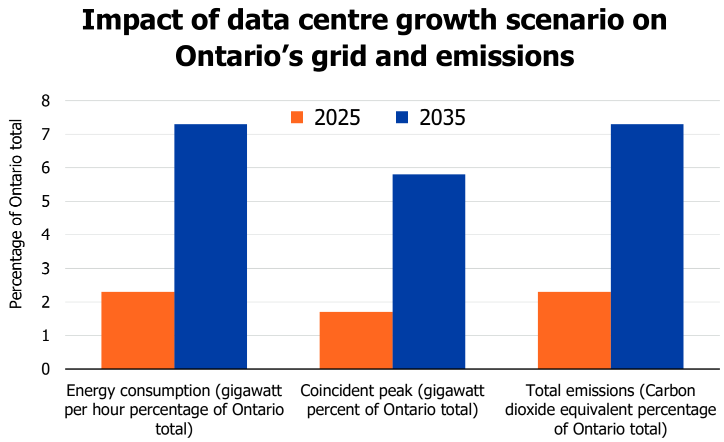
Ontario-wide, the scenario baseline implies that by 2035, data centres will account for 7.3 percent of total electricity consumption, 5.8 percent of coincident peak load and 7.3 percent of total emissions (see Graph 1[3]). Given current infrastructure and market trends, most new inference-based cloud capacity is expected to be created in or near Toronto. As a result, GTHA impacts are more pronounced with data centres consuming 10 percent of the region's annual

[2] Forecasting calculations were high-level calculations that used available data and estimates. For more precise results, more detailed modelling would be required.

[3] ISEO's Annual Planning Outlook for 2024.

electricity demand (11,000 gigawatts/hour), 8 percent of coincident peak load (1.2 gigawatts) and 10 percent of total carbon emissions (900 kilotonnes of carbon dioxide equivalent)[4]. Based on expert input and market activity, it's estimated that 25 percent of new development in the GTHA may concentrate in Toronto, with the remaining 75 percent distributed across the other GTHA planning regions (see Figure 1).

Graph 1: Impacts of the 1.5-gigawatt baseline data centre growth scenario on Ontario's electricity system and emissions

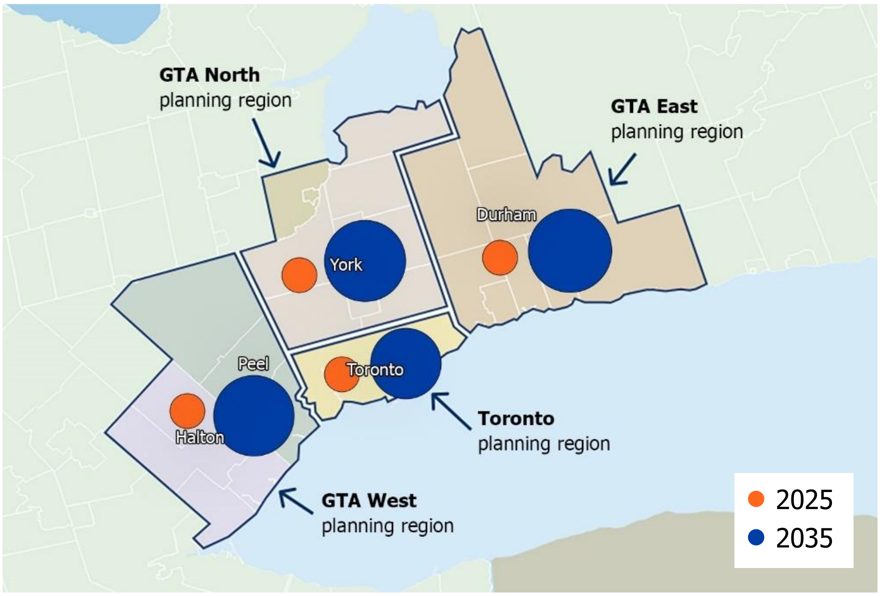


PRIORITIZATION UNDER COMPETING DEMAND

As the pace of electrification accelerates, Ontario faces increasing competition from other major electricity needs. Data centres are high-leverage users of power: they can support productivity, innovation and sovereignty, but they also create high, continuous demand for electricity. Clear guidance can help government and system operators prioritize projects that deliver strong public value and system benefits, while ensuring growth remains compatible with reliability, affordability and emissions objectives.

Figure 1: Geographic distribution of the 1.5-gigawatt baseline data centre growth scenario across the GTHA

Energy demand from data centres in GTHA regions



Source: Original GTHA map courtesy IESO; data modelling by Mantle Climate.

4 Longer term, Ontario's new inference capacity may expand beyond the GTHA as Ontario's cities evolve.

Defining mitigating solutions

Regardless of the exact pace of growth, data centres will materially impact electricity demand, peak capacity and emissions over the coming decade. The 10-year time horizon is important to note, as Ontario's new nuclear and other low-emission investments may begin to come online shortly thereafter, which could significantly alter the solution landscape beyond 2035. Some solutions, such as demand response and waste heat reuse, may by point have become the status quo for large-scale development, while others, like on-site generation for prime power, may evolve toward more flexible or backup-oriented roles as grid capacity expands.

Workshop participants identified a shortlist of feasible impact-mitigating solutions that could be deployed over the 10-year horizon[5]. Other emerging and longer-term decarbonization solutions and pathways remain important for ongoing investment and policy development, but may not yet be commercially scalable at the levels required for data centres within the next decade. See Appendix C for the complete list of solutions reviewed in the second workshop.

Demand response: Reducing or shifting demand during peak periods by curtailing load or switching to on-site generation or energy storage. This is increasingly incentivized or required globally for large data centres, given the outsized positive impact it has by getting more out of existing systems.

On-site (behind-the-meter) generation: On-site, prime electricity generation to power data centre operations in areas that are grid-constrained. Given the energy density and 24/7 load of data centres, developers are increasingly turning to natural gas generation to provide this.

Clean power purchase agreements (PPAs): Long-term clean energy contracts that bring new clean generation online and offset emissions. PPAs fund clean energy projects, resulting in new energy generation coming onto the grid.

Waste heat reuse, including district heating: The process of capturing and repurposing thermal waste energy to heat nearby buildings or industrial processes, reducing system-wide heating demand and emissions. Data centres generate a tremendous amount of low-grade waste heat that could be repurposed this way.

Energy storage: Primarily battery systems to support demand response and backup supply.

[5] Workshop participants agreed that low-carbon construction practices are a feasible mitigating solution, but it was beyond the scope of this project.

Participants also emphasized the value of purpose-built data centre hubs, coordinated from the outset to integrate energy solutions — an approach that is still relatively rare in Ontario. While most data centre development has largely not been coordinated in this way, developers are showing signs of being more open to it. In a power-constrained environment (a descriptor that characterizes much of the Western world), data centre revenue is increasingly curbed by access to energy, which in turn creates urgency to innovate in energy sourcing and system design. Where co-located infrastructure development and mitigation measures can enable faster access to energy, factors that may have been viewed as barriers are increasingly seen as acceptable trade-offs.

Community concerns are also increasingly shaping development, underscoring the need for solutions that deliver local benefits and address system impacts. Overall, a coordinated, portfolio-based approach is required to manage the effects of data centre growth. Successful co-located infrastructure development efforts have incorporated early and ongoing community engagement, helping to manage these concerns while supporting responsible growth.

SUSTAINABILITY AS GOVERNANCE TOOL

In a capacity-constrained system, sustainability can serve as a governance tool. Setting expectations for mitigation readiness, such as demand response participation, heat reuse feasibility, efficiency, use of low-carbon fuels and low-carbon construction, can help Ontario screen, prioritize and shape large-load growth, so that it delivers higher economic output per megawatt, reduces system risk and improves community outcomes. Clear standards can also reduce uncertainty for proponents by making requirements more predictable.

Growth scenario case studies

Overview

To assess how impact-mitigating solutions may influence system-level outcomes under different growth conditions, the project team developed four illustrative case studies. These were reviewed and discussed by participants in the third and final workshop. They were designed as end-of-decade snapshots, rather than forecasts, reflecting conditions Ontario may need to plan for over the coming years.

The case studies examine two potential growth trajectories: a baseline scenario of 1.5 gigawatts and a higher growth scenario of 3 gigawatts, paired with low and high levels of adoption of mitigating solutions. In this context, low and high adoption refer to the relative extent to which solutions are deployed and coordinated, rather than judgments about project quality or desirability. The underlying assumptions are grounded primarily in data centre growth concentrated in the GTHA, with impacts assessed at the provincial electricity system level. This framework allowed participants to explore how varying levels of data centre growth interact with the electricity system under different mitigation conditions.

Under the 1.5-gigawatt growth scenario, Ontario's electricity system could largely accommodate the increased load within existing and planned grid expansion. In this context, mitigating solutions could play an important role in supporting broader system electrification while significantly curtailing emissions. In contrast, under the 3-gigawatt growth scenario, current planned grid expansions would be insufficient to meet demand. Substantial on-site generation would be required to address capacity shortfalls. Currently, natural gas is the leading commercially available option with enough energy density to support large data centre loads. While PPAs could partially offset emissions, even significant adoption of other solutions would be insufficient to alleviate the most substantial emissions impacts.

Each case study was evaluated across the three impact areas to better understand the extent to which measures could reduce energy use, capacity impacts and emissions under different growth conditions. Workshop discussions informed the identification of key barriers and opportunities shaping Ontario's near-term data centre growth, as well as the conditions required to pursue that growth sustainably.

WHAT'S NEEDED TO ENABLE GROWTH

Realizing these growth and mitigation pathways will require enabling conditions beyond technical solutions alone. These include supportive policies and the identification of sites with existing or feasible grid and natural gas connections, adequate land availability and access to high-capacity fibre. Sufficient local labour and construction capacity will also be needed to meet accelerated timelines, along with opportunities to reuse energy to improve overall system sustainability and efficiency where possible. Siting, infrastructure and workforce considerations play a critical role in determining whether growth at this scale could be realized in practice.

1.5 gigawatts of growth with low adoption of mitigating solutions

This case study represents the baseline growth scenario, reflecting an additional 1.5 gigawatts of data centre load by the end of 2035. At this level, Ontario's electricity system is expected to accommodate the increased demand within existing and planned grid expansion. Mitigating solutions can help reduce system impacts and support broader electrification initiatives in the province, such as electric vehicles, public transit, electrified manufacturing and other public infrastructure.

Under the low adoption of mitigating solutions case, only demand response and district energy are considered. These solutions were selected because they are already in use or have been piloted in Ontario and can be implemented with relatively limited system-level change. In this case, demand response helps offset coincident peak demand, while district energy reduces total electricity consumption and associated emissions.

Case study #1 highlights the incremental benefits achievable through readily available mitigation options under a manageable growth scenario.

Figure 2: Case study #1 summary

Solution	Market penetration	System impacts: total energy	System impacts: coincident peak	System impacts: GHG emissions
Demand response	Medium	—	↓	—
District energy	Medium	↓↓	—	↓↓

CASE STUDY #2

1.5 gigawatts of growth with high adoption of mitigating solutions

This case study examines the same 1.5 gigawatt-growth scenario, but with higher adoption of coordinated mitigating solutions. This scenario reflects a more proactive and integrated approach to managing impacts under a growth level that the system can largely accommodate.

A combination of waste heat reuse solutions and on-site prime power, assumed to be natural gas paired with local clean power PPAs, reduces the total electricity consumption impacts from data centres. Coincident peak is addressed largely by the same solutions, with the addition of demand response. Emissions are reduced primarily through waste heat reuse.

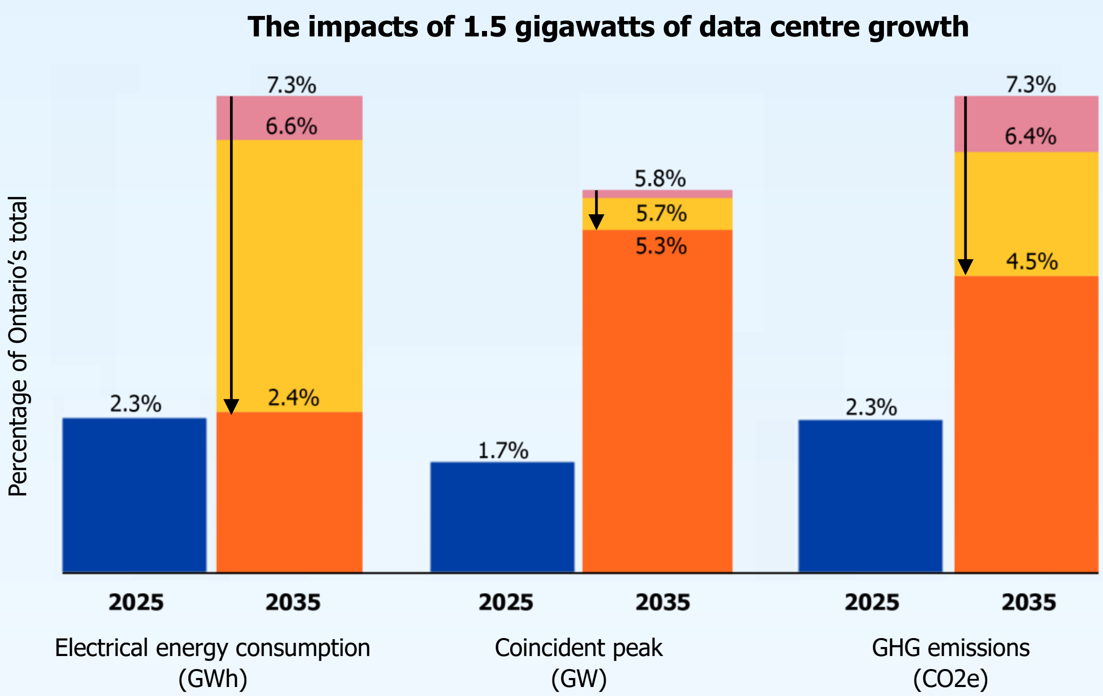
Case study #2 demonstrates that greater adoption of mitigating solutions can improve system performance and flexibility in a manageable growth scenario.

Figure 3: Case study #2 summary

Solution	Market penetration	System impacts: total energy	System impacts: coincident peak	System impacts: GHG emissions
Demand response	High	—	↓	—
District energy	High	↓↓	—	↓↓
District energy + thermal storage	Low	↓	↓	↓
Waste heat recovery	Medium	↓↓	—	↓↓
Natural gas prime + local PPA	Low	↓↓	↓	—

Different levels of mitigation affect the electricity system and emissions outcomes under the 1.5-gigawatt growth scenario (see Graph 1). Based on case studies 1 and 2, mitigating solutions meaningfully reduce total electricity impacts and emissions, but have a more limited impact on coincident peak demand. Achieving larger peak reductions would require broader and more consistent participation in demand response programs, or greater reliance on on-site generation to manage peak periods.

Graph 2: System impacts of 1.5 gigawatts of data centre growth under low and high mitigating solution adoption (Case studies #1 and #2)



This graph shows the potential reduction of impacts in Case study #1 (shown in pink) and #2 (shown in yellow). Case study #2 clearly has a more significant impact on electricity consumption and emissions. However, it doesn't have much impact on coincident peak. (See the paragraph above for more detail.)

- Current state
- Case study #1
- Case study #2
- Unabated impacts
- ↓ Potential reduction in impact

3 gigawatts of growth with low adoption of mitigating solutions

This case study represents a high-growth scenario in which Ontario significantly expands data centre capacity by 3 gigawatts by the end of 2035. It is important to note that workshop participants generally acknowledge that this level of growth would only be achieved if policy-makers enacted new regulations to promote the development of data centres. At this level, growth cannot be accommodated under current grid expansion plans and would need to be supplemented by significant on-site generation.

This pathway assumes low adoption of mitigating solutions, primarily focused on maintaining grid reliability. On-site prime power would need to be deployed to reduce reliance on the grid for total electricity demand and coincident peak load. As noted above, this is most likely to be provided by natural gas. If left unmitigated, the impact of the GHG emissions generated would be significant[6].

Case study #3 illustrates that under constrained system capacity, a low-level adoption of mitigating solutions enables growth but cannot meaningfully limit environmental impacts.

Figure 4: Case study #3 summary

Solution	Market penetration	System impacts: total energy	System impacts: coincident peak	System impacts: GHG emissions
Natural gas prime	High	↓↓↓	↓↓↓	↑↑↑↑

[6] The emissions impact of natural gas prime power is based on annual grid emissions factors. For peak load emissions, the model assumes on-site natural gas generation displaces average grid electricity. In reality, peak-period demand in Ontario is largely met by gas-fired generation, with emissions reflected in marginal emissions.

3 gigawatts of growth with high adoption of mitigating solutions

This case study examines the same 3-gigawatt growth scenario, but with higher adoption of coordinated mitigating solutions. Under these conditions, total electricity demand can be met primarily through natural gas prime power paired with local clean power PPAs to partially offset on-site generation emissions . Additional contributions would come from demand response and a combination of waste heat reuse solutions, including district energy, thermal storage and other forms of waste heat recovery. Coincident peak can be curtailed through a combination of on-site power generation, demand response and district energy paired with thermal storage. While waste heat reuse solutions can reduce the system-level emissions impact, on-site emissions most likely introduced by natural gas generation exceed those reductions.

Case study #4 shows that even with the high adoption of mitigating solutions, enabling greater data centre growth over the next 10 years requires trade-offs, particularly between maintaining system reliability and managing emissions.

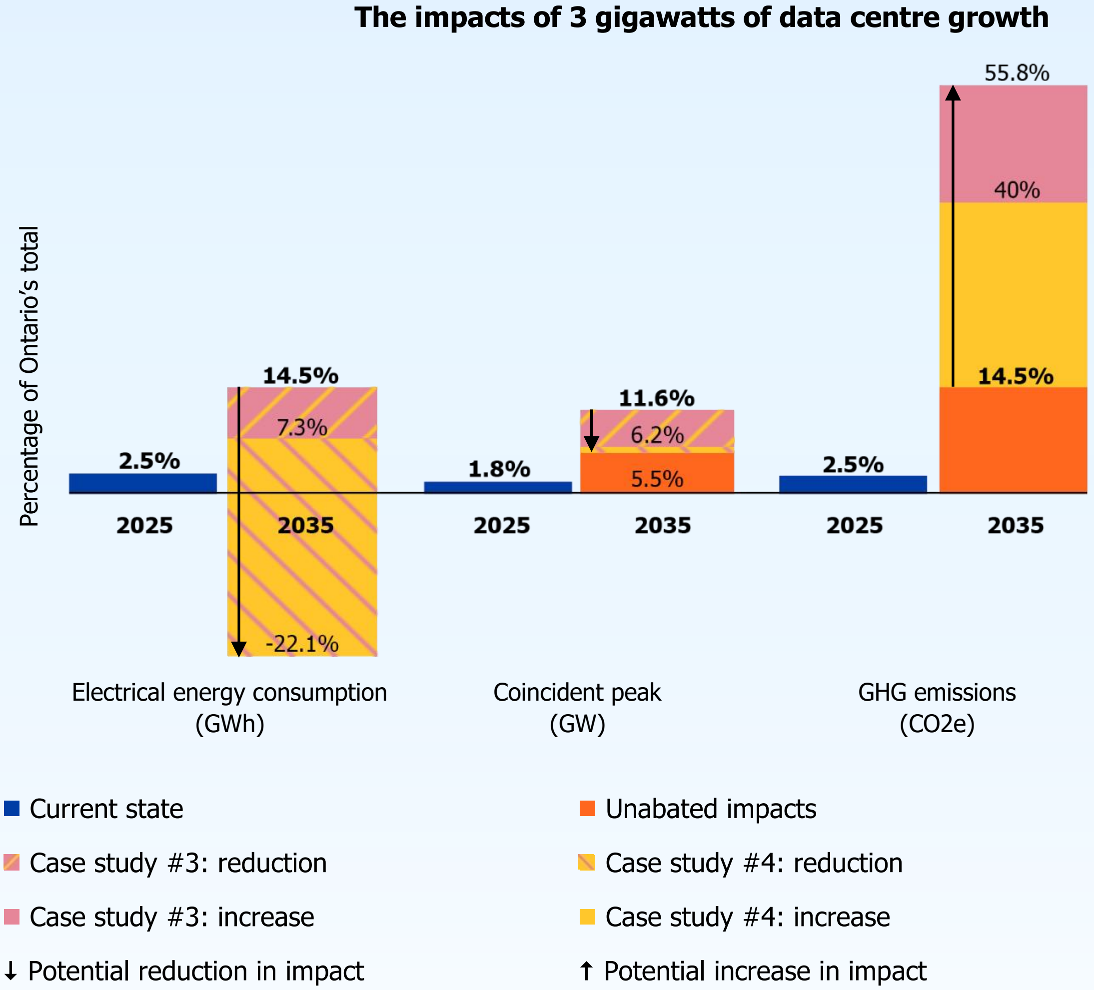
Figure 5: Case study #4 summary

Solution	Market penetration	System impacts: total energy	System impacts: coincident peak	System impacts: GHG emissions
Natural gas prime + local PPA	Low	↓↓↓↓*	↓↓↓	↑↑↑
Demand response	High	—	↓	—
District energy	High	↓↓	—	↓↓
District energy + thermal storage	Low	↓	↓	↓
Waste heat recovery	Medium	↓	—	↓↓

* Energy generation from local clean power PPAs lead to net electricity generation.

Graph 2 summarizes system and emissions outcomes under the 3-gigawatt growth scenario, where mitigation measures are required primarily to maintain grid reliability and stability, with the likely trade-off of higher emissions. Notably, if developers push for on-site prime power paired with local clean PPAs, the results indicate data centres could, at times, be net annual generators of electricity in the province, despite their large on-site energy requirements.

Graph 3: System impacts of 3 gigawatts of data centre growth under low and high mitigating solution adoption (Cases studies # 3 and #4)[7]. Bolded values indicate baseline conditions.



This graph shows the trade-off between grid stability and higher emissions. It shows the potential reduction of impacts on energy consumption and coincident peak (shown in striped pink for Case Study #1 and striped yellow for Case Study #2) and increase in emissions (pink for Case Study #3 and yellow for Case Study #4).

[7] The 3-gigawatt growth scenario assumes an initial annual growth rate of 20% compared to 13% in the 1.5-gigawatt growth scenario.

Challenges and opportunities

Building on the four case studies, workshop discussions highlighted where impact-mitigating solutions are feasible today, where system or business constraints limit adoption and why certain strategies are more effective under specific growth conditions. These insights point to the structural, policy and market factors that will shape Ontario's near-term options.

Strategic positioning and system priorities

Barrier: Ontario's evolving strategic position

Ontario is still defining how data centres fit within its broader economic, infrastructure and energy priorities. While recent initiatives, such as Bill 40 and emerging digital strategies, signal direction, data centres are not yet consistently integrated into provincial planning frameworks.

Opportunity: Strategic alignment with competitiveness and sovereignty objectives

Policy and regulatory clarity will streamline decision-making and investment. Participants emphasized the importance of considering how different levels of data centre capacity would shape Ontario's future, including impacts on jobs, investment, innovation, other electrification priorities and electricity costs for ratepayers.

Market competitiveness, costs and incentives

Barrier: Competitiveness and cost predictability for energy and early-stage financing

Participants noted that differences in electricity pricing, tariff structures and cost predictability can influence Ontario's competitiveness relative to other data centre markets, such as Texas and Wisconsin. Large energy users require long-term cost certainty and reliability. These challenges are amplified when sustainability expectations are imposed early in project development without supportive financing mechanisms.

Opportunity: Leveraging and optimizing existing programs and incentives

Participants identified opportunities to better align or enhance existing programs to support sustainable development. International examples, particularly in Nordic countries and parts of the U.S., demonstrate that targeted tools, such as tax incentives, cleantech credits, early-stage funding mechanisms, accelerated depreciation and favourable terms for consortium projects, can improve market attractiveness while reinforcing responsible growth.

Participants also highlighted the value of updating energy programs and tariffs to reflect the operating characteristics of emerging large loads, including their flexibility potential and system impacts.

Regulatory processes and permitting

Barrier: Misaligned and complex permitting processes

Across discussions, regulatory and permitting challenges were consistently cited as significant challenges. Data centre development timelines often do not align with real estate cycles, utility connection processes or municipal approvals. Overlapping provincial and municipal requirements, combined with unclear sequencing across land-use planning, grid connections and construction permitting, create uncertainty rather than simply extending timelines.

Participants also highlighted gaps in guidance on sustainable construction, uncertainty around Canadian data sovereignty requirements, and unclear alignment between provincial and municipal decision-making. These factors increase development risk, delay mitigation deployment and complicate efforts to ensure projects reinforce broader system and policy goals.

Opportunity: Streamlined and coordinated regulatory pathways

Participants discussed how improved coordination across permitting and approval processes could help reduce friction while maintaining appropriate regulatory oversight. A clearer division of responsibilities, predictable sequencing of approvals, and alignment between land-use, utility and sustainability requirements would give proponents more certainty and support consistent implementation of mitigation expectations. Participants stressed that the objective is not speed for its own sake, but coherent, transparent pathways that enable responsible development under constrained system conditions.

Co-located infrastructure development and cross-sector coordination

Barrier: Fragmented planning and decision-making

In the absence of clear alignment on roles and sequencing, fragmented planning across government, utilities, developers and communities, can be difficult to catalyze coordinated, co-located infrastructure development. This fragmentation increases development risk, constrains infrastructure efficiency and makes it more challenging to align data centre growth with system capacity and community objectives.

Opportunity: Coordinated, co-located infrastructure development

Participants identified coordinated, co-located infrastructure development as a critical opportunity to manage grid impacts, energy requirements, emissions and community outcomes more effectively. Collaborative planning involving provincial and regional governments, utilities, data centre developers, supply chains, Indigenous groups and communities could support integrated energy planning based on real-world supply and constraints.

A unifying, coordinating body was also identified as a potential opportunity to facilitate this type of continued collaboration among interested parties, such as those involved in this project. This may be overseen by the province or others. As an initial step, such a group could map land and availability of electricity and gas, identify priority development areas, and help streamline permitting and access requests, without replacing existing authorities.

Mitigation readiness and deployment

Barrier: Uneven access to proven mitigating solutions

While many mitigating solutions are commercially viable and proven, participants noted that availability does not guarantee uptake. Program design, access and alignment with operational realities remain hurdles.

Opportunity: Formalizing and enabling viable mitigating solutions

Workshop results indicate that widespread demand response, waste heat recovery and energy efficiency are essential, especially in a high-growth scenario. Local clean power PPAs and on-site, likely gas-fired, power were also considered viable. Clear expectations, standardized program structures and alignment with system needs, particularly peak periods, would help scale these solutions and improve system outcomes.

Natural gas as a near-term reliability solution

Opportunity: Managing near-term reliability and capacity requirements

Under high-growth scenarios, natural gas was identified as a practical solution to maintain reliability and to meet capacity requirements over the next 10 years. It can address near-term energy constraints, particularly where electricity infrastructure or lower-carbon alternatives cannot be deployed quickly enough to meet demand.

The coming decade represents a period of significant system build-out, as Ontario completes major nuclear refurbishments and advances new nuclear and renewable capacity. In this context, natural gas can complement long-term clean generation expansion by supporting system adequacy during a constrained period. As additional low-carbon capacity comes online, its role could evolve from continuous supply toward a more flexible, grid-supporting reliability resource. Ontario is progressing along this pathway through IESO's LT1 and LT2 procurements and the refurbishment of the Pickering Nuclear Generating Station and planning for new nuclear development at the Bruce and Wesleyville sites, which are expected to play a central role in meeting future baseload demand.

Developing on-site gas generation, however, comes with practical challenges. Many jurisdictions in Ontario have regulations that limit new installations. Where feasible, co-location with heat off-takers could improve overall efficiency by enabling productive reuse of waste heat for industrial or community applications.

Supply chains and regional development

Opportunity: Strengthen Canadian supply chains

Coordinated infrastructure development was also identified as an opportunity to strengthen Canadian supply chains by involving suppliers earlier in the development process and enabling longer-term collaboration. This approach aligns with the province's broader "Buy Ontario" and domestic procurement objectives by supporting Canadian jobs, skilled labour and manufacturing capacity across construction, energy and technology supply chains. Earlier engagement and longer-term supply contracts could support efficiencies in equipment and fuel use between data centres and nearby communities, while helping to build more resilient local and domestic supply chains over time.

Opportunity: Low-carbon construction and domestic manufacturing

Data centres rely heavily on such carbon-intensive materials as concrete and steel. Coordinated early engagement with Ontario's low-carbon producers can help scale cleaner materials, reduce embodied emissions and enhance domestic manufacturing competitiveness. Clear sustainability expectations and predictable demand signals would support investment in lower-carbon technologies and build skilled trades capacity. In this way, data centre growth can contribute not only to digital infrastructure, but also to the development of cleaner, more competitive construction supply chains in Ontario.

Opportunity: Development in Northern Ontario

Northern Ontario offers potential opportunities, including available capacity and emerging industrial investments, alongside the potential for Indigenous partnership. However, participants highlighted that challenges, such as fibre connectivity costs, talent availability, application latency and investment attraction, limit widespread deployment. Northern sites may be viable for specific co-location use cases, rather than as a general solution.

Overall, these barriers and opportunities highlight where targeted policy action, coordinated planning and early intervention can meaningfully shape Ontario's near-term data centre growth trajectory.

ATTRACTING THE RIGHT DATA CENTRES

Ontario is well-positioned to attract investment in AI-ready digital infrastructure, but electricity capacity is increasingly valuable and contested. Policy can help ensure Ontario attracts the right projects — those that are additive to communities by supporting jobs and sovereignty, demonstrating mitigation readiness, contributing to system resilience and avoiding undue cost impacts on other ratepayers. With transparent criteria and coordinated pathways, Ontario can remain competitive while protecting reliability, affordability and the environment.

Recommendations

Based on the project's research findings and workshop discussions, the following recommendations outline near-term actions to support high-value data centre growth through policy alignment, targeted pilots and ongoing cross-sector collaboration.

Policy

Effective policy will shape not only the scale of data centre growth, but also which projects advance, under what conditions, and with what system and community outcomes. Significant growth will place increasing pressure on the electricity system, but its impacts can be mitigated through clear, coordinated policies. In the near-term, as grid constraints intensify and demand accelerates, policy intervention will be critical to enabling economically competitive growth while maintaining alignment with Ontario's energy, climate and community objectives.

Key policy elements identified through this project include:

1. **Prioritize grid access for high-value projects**: Initiatives that demonstrate clear value to Ontario's economic competitiveness, data sovereignty and host communities should be given priority. These criteria can help clarify Ontario's intended role in the global digital infrastructure landscape and guide decisions during periods of constrained capacity.

2. **Establish requirements for mitigation readiness**: These could include demonstrated feasibility and planned utilization of critical solutions, such as on-site generation, demand response, waste heat recovery, energy efficiency, and sustainable design and construction practices using Ontario supply chains. Providing clear guidance on acceptable and preferred approaches would support consistent implementation and reduce uncertainty for project proponents.

3. **Enable siting and coordination that are aligned with electricity system constraints**: This is particularly important where proximity to supply, behind-the-meter power arrangements, or coordinated development with generators is feasible. Early engagement among data centre developers, utilities and generators can help reduce system impacts, improve reliability outcomes and limit the need for incremental grid infrastructure.

4. **Apply screening mechanisms for large-load applicants**: Using the above elements as criteria can help utilities distinguish between speculative proposals and projects with credible development plans, system benefits and near-term viability.

5. **Create streamlined and coordinated permitting processes**: These can better align land-use planning, utility processes and sustainability requirements to reduce delays and development risk while maintaining oversight. Predictable sequencing is as important as shorter timelines.

6. **Fast-track development pathways and targeted incentives**: Projects that meet defined economic criteria and responsible development parameters could be given priority, particularly those that demonstrate early adoption of mitigation measures and contributions to system flexibility or emissions reduction.

7. **Develop mechanisms for accountability and monitoring**: These measures could include tracking performance on energy, emissions and system reliability to inform future policy adjustments as the sector evolves.

Workshop participants also emphasized the value of centralized coordination and oversight, potentially through a unifying body responsible for enabling coordinated, co-located infrastructure development, aligning regulatory processes, managing growth, as well as coordinating across government, utilities, industry and communities. Such an approach could also support more balanced regional development by ensuring that the benefits of digital infrastructure investment are distributed across Ontario.

Ontario's recent passage of Bill 40, alongside other existing and emerging policy instruments, provides a practical mechanism to support the policy objectives outlined above. Applied transparently and consistently, these instruments can prioritize projects that deliver broader public value while protecting system reliability and ratepayer affordability.

Pilot projects

Demonstrating how responsible data centre development works in practice will require coordinated, real-world projects. Workshop participants identified the value of pursuing a co-located data centre pilot development, designed and delivered through collaboration among multiple sectors. A data centre co-located within a new community or industrial development would allow Ontario to test mitigation strategies, governance models and planning approaches before scaling.

A pilot project would provide insight into the end-to-end development process, including siting, permitting, grid connection, on-site generation, heat reuse infrastructure, design, construction and operations. This approach would help identify bottlenecks, regulatory misalignments and infrastructure constraints. It would also inform refinements to policy frameworks. Clear evaluation criteria, such as impacts on grid reliability, emissions performance, project timelines and community benefits, would support translation of pilot learnings into scalable policy and practice.

Co-location is well-suited to projects that serve specific digital sovereignty goals. As such, potential pilot locations include publicly owned lands or institutional partnerships, such as government-owned sites and universities, or areas where major development is already planned. To pilot with a university campus, provincial or federal governments could facilitate site selection through a competitive request for proposal, acting as conveners and risk-reducers, while project proponents retain responsibility for delivery and operations.

Forum for ongoing collaboration

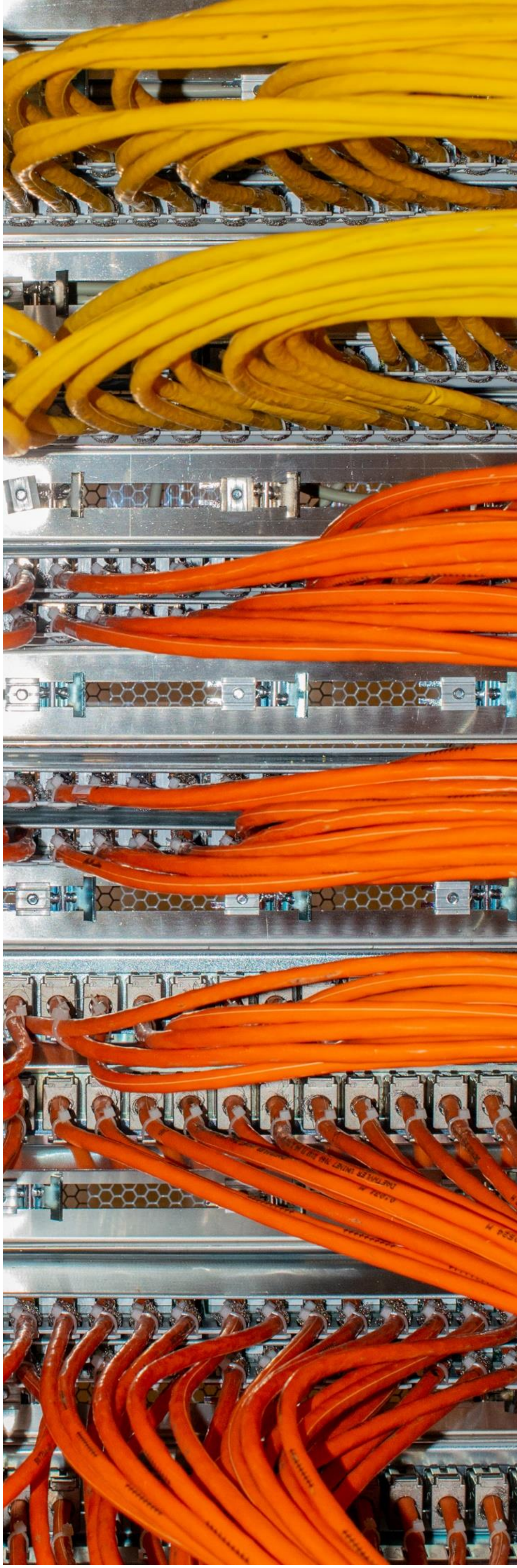
Participants emphasized that sustainable, co-located development will require continued coordination across sectors. A standing forum would provide a structured way to maintain momentum, share insights and respond to rapidly evolving technology, market dynamics and policy frameworks. It could help break down sectoral silos that often limit coordination and impede optimal outcomes.

This project's multi-party workshops surfaced critical insights that would not have emerged through bilateral engagement alone. Workshop participants expressed strong interest in continuing coordinated discussions to address the rapidly evolving technical, market and policy dimensions of data centre growth.

In Ontario, such a forum could take multiple forms, including semi-regular convenings, a standing advisory committee or a structured working group supported by government. Regardless of the format, participants emphasized the value of a forum with a clear mandate to:

- Support regular information exchange across government, utilities, operators, regulators and communities
- Update modelling, assumptions and best practices
- Identify emerging risks and opportunities before they become binding constraints
- Ensure ongoing consideration of economic and community impacts, affordability and environmental performance
- Produce shared research, guidance or design standards

Establishing clear objectives, defined participation and regular outputs, such as shared research findings or updated guidance, would help translate discussions into actionable insights and maintain momentum for sustainable growth over time.



Building a foundation

As the province enters an accelerated phase of growth, strategic collaboration and informed decisions are critical to support resilient digital infrastructure.

Ontario is well-positioned to benefit from and help shape the next generation of sovereign digital infrastructure. Balancing economic competitiveness, security, climate goals and community needs is complex but essential, as access to digital infrastructure is becoming as fundamental as roads and electricity. At the same time, the pace of change across AI, data centre development and energy systems is accelerating, narrowing the window for coordinated, informed decision-making.

This project highlights that decisions about data centre growth have meaningful system-wide implications. How Ontario prioritizes, situates and enables large electricity loads will directly influence system reliability, emissions trajectories, affordability for other ratepayers and the economic value generated from scarce electricity capacity. Unguided, growth risks increasing system pressure and crowding out other priority electrification needs. With deliberate policy, coordination and mitigation, the same growth can strengthen the energy system and support climate commitments, while also delivering durable economic and community benefits.

The analysis and discussions captured in this report provide a shared, evidence-based foundation to support these choices. They point to the importance of clear screening criteria, coordinated and co-located infrastructure development, and early alignment across government, utilities, industry and communities. In this context, sustainable development is not an add-on — it is a practical tool for prioritization, productivity and risk management in a capacity-constrained system.

Decisions made in the next three to five years, well before major new clean generation comes online, will determine whether AI infrastructure growth strengthens or strains Ontario's energy systems and communities. As growth trajectories, technologies and policy frameworks continue to evolve, ongoing collaboration will remain essential. This project was intended to kick-start collaboration and support informed, timely decision-making to support smart digital infrastructure development as Ontario enters its next phase of growth. The province can use this window to build AI-ready digital infrastructure that is additive — strengthening sovereignty and competitiveness while sustaining a reliable, affordable and low-carbon energy system.

Participating organizations

We are grateful for the support of The Atmospheric Fund and our advisory committee members.

Project team

Mantle Climate

Kathleen Kauth, COO
Irene Lam, Director
Joshua Mogil, Senior Advisor
Mai-Yin Johnston, Advisor

MaRS Discovery District

Tyler Hamilton, Senior Director, Climate
Ria Perrault, Manager, Climate Programs
Olivia Lang, Coordinator, Climate Programs

Advisory committee

Enbridge Gas Inc.
Hydro One
Independent Energy System Operator (IESO)
Ontario Power Generation (OPG)
Toronto Hydro

Interviewees and workshop participants

Acronym Solutions

Ampere Computing

Canadian Infrastructure Bank

CBRE

City of Toronto

Cologix Canada

Compass Datacenters

Compute Ontario

CORE Data Centres

Cushman & Wakefield

Deloitte

Enersion

Enwave

Extract Energy

iMasons Climate Accord

Innovation, Science and Economic Development Canada (ISED)

Intermarket Properties

Ministry of Economic Development, Job Creation and Trade (MEDJCT)

Ministry of Energy and Mines

MegaWatt Consulting

Ontario Energy Board

Red Jar Energy Partners

Telehouse Canada

ThermaCity Energy

Sussex Strategy

Untether AI

Urbacon

Vector Institute

Scenario modelling assumptions

To model the baseline scenario and the case studies, the following assumptions were applied to simplify calculations within the scope and limitations of the project:

- Data centre growth reflects the policy and regulatory landscape as of June 2025 at the start of workshop discussions.
- Assumptions related to electricity demand and supply growth in Ontario are based primarily on the IESO's 2024 APO, which was the most current available during the research period.
- Published projections for average and marginal grid emission factors remain accurate and will be unaffected by additional data centre loads.
- Nameplate capacity, or the maximum theoretical IT power that a facility is designed to support, represents the real load demand (i.e., 100 percent uptime).
- All new inference growth will occur in the GTHA, and all training growth will occur elsewhere in the province.
- Increased compute efficiency from improved technological capabilities will be offset by greater compute requirements and therefore were not modelled.

Additional important notes on the methodology used include:

- The model excludes the energy required or impacts associated with retrofitting existing data centres.
- The emissions impact of natural gas prime power is based on annual grid emissions factors. For peak load emissions, the model assumes on-site natural gas generation displaces average grid electricity. In reality, peak-period demand in Ontario is largely met by gas-fired generation, with emissions reflected in marginal emissions factors. Because peak on-site gas would primarily displace other gas generation, using average grid emissions likely overstates the incremental impact, making this assumption conservative.
- The first 1.5 gigawatts of data centre growth that will occur in Ontario is largely included in the current IESO system planning assumptions. Any additional growth (the remaining 1.5 gigawatts in the higher 3-gigawatt case studies) represents incremental demand beyond all loads included in the IESO's 2024 APO.
- Mitigating solutions considered for each case study were selected based on expert input and workshop discussions on the feasibility, commercial viability and potential system impact. Appendix C provides a complete list of mitigation options reviewed during the project and their relevance to the analysis.

Considered solutions

The table below summarizes the impact-mitigating solutions considered in this project, along with a brief description and an assessment of whether each is expected to be feasible and commercially viable within a 10-year timeframe for data centre applications in Ontario.

Solution name	Description	Feasible and commercially viable in 10 years?
Carbon capture, utilization and storage (CCUS)	Technologies that capture carbon dioxide from industrial processes or directly from the atmosphere for storage or reuse. Although significant investments continue in advancing this technology, CCUS at scale requires new enabling infrastructure to support its commercialization. While promising, it is unlikely to support meaningful emissions reductions for gas generation in Ontario within the next decade.	No
Clean power purchase agreements (PPAs)	Long-term contracts (typically 10 to 20 years) between a clean energy generator and a corporate or utility buyer for the purchase of electricity at an agreed price. PPAs enable new clean generation to be developed and allow purchasers to claim associated emissions reductions. For this study, PPAs were assumed to support new Ontario-based renewable projects, primarily solar photovoltaic installations due to construction timelines.	Yes
Demand response	Programs and operational strategies that reduce or shift electricity consumption during peak demand periods. Demand response is widely viewed as a leading option for managing large data centre grid impacts and is increasingly incentivized or required in various jurisdictions.	Yes
Energy storage systems	Technologies that store energy for later use to support reliability, peak management and system flexibility. The project considered multiple storage modalities with different maturity levels and applications.	
• Battery energy storage systems	Rechargeable battery systems (e.g., lithium-ion) that store electricity from the grid or renewables for later use.	Yes

Solution name	Description	Feasible and commercially viable in 10 years?
• Thermal storage systems	Systems that store thermal energy from electricity or waste heat for later use. * For modelling purposes, a conservative adoption rate was applied to reflect uncertainty regarding scalability for large data centre applications within the study timeframe.	Yes*
Fuel cells	Electrochemical devices that convert fuel (typically natural gas or hydrogen) directly into electricity without combustion. In some data centre applications, they are increasingly deployed as modular on-site power solutions. * At the scale of projected growth in Ontario, large deployments would remain dependent on natural gas or hydrogen infrastructure and would function similarly to other forms of on-site generation. For this reason, fuel cells were considered commercially viable but not modelled as a distinct mitigation pathway.	No*
Low-carbon construction	Practices that reduce embodied emissions from material production, transportation and installation during construction. Lower-carbon concrete and steel options are commercially available and can reduce upfront emissions. * While not modelled quantitatively in this study, these practices contribute to overall emissions reduction.	Yes*
Lower-carbon fuels	Alternative fuels that reduce lifecycle emissions relative to conventional fossil fuels. Potential applications include backup or prime power, depending on fuel type and availability. For data centres, these fuels are primarily relevant for emergency backup power generation rather than for continuous operation, given the relatively low supplies available. Most options face supply, cost or infrastructure constraints at the scale required for large data centre deployment.	
• Renewable natural gas	Methane captured from decomposing organic waste upgraded to pipeline quality fuel. While commercially available and used in Ontario today, renewable natural gas has supply constraints that limit its ability to scale sufficiently to meet large data centre demand within the next decade.	No
• Biofuels	Renewable fuels derived from biomass, such as ethanol and hydrogenated vegetable oil (HVO). Current and projected supply levels are insufficient to support large-scale data centre deployment.	No

Solution name	Description	Feasible and commercially viable in 10 years?
• Green hydrogen	Hydrogen produced via electrolysis using renewable electricity. While promising for long-term decarbonization, current production represents a small fraction of total hydrogen supply and faces significant scaling challenges.	No
• Blue hydrogen	Hydrogen produced from natural gas with carbon capture and storage. While it is considered a transitional fuel and contains less carbon than conventional hydrogen, deployment and supporting infrastructure are unlikely to scale sufficiently within the study time frame.	No
• Methane pyrolysis (turquoise hydrogen)	A thermochemical process that converts methane (natural gas) into hydrogen and solid carbon. While potentially suitable for low-carbon baseload power in the future, the technology is not yet commercially available at scale.	No
Nuclear	Large-scale electricity generation technology that produces power through nuclear fission, generating low-carbon, firm baseload electricity. * In Ontario, nuclear power plays a central role in the provincial electricity mix and long-term decarbonization strategy. However, new nuclear capacity and refurbishments currently underway are expected to come online after 2035 and therefore fall outside the modeling timeframe of this study.	No*
On-site/behind-the-meter: prime generation	Continuous, on-site generation used when grid capacity is insufficient. ***** For data centres, natural gas is currently the only commercially viable fuel capable of providing continuous high-density supply. Due to land constraints and the need for near-continuous uptime, renewables are generally impractical given current storage costs and land availability. Prime power can operate year-round and is increasingly deployed as a transitional solution that shifts to backup-only use as grid capacity expands over time.	Yes*****
On-site/behind-the-meter: backup generation	Emergency on-site generation used during grid outages. Historically diesel-based, with increasing use of natural gas. In some jurisdictions, limited peak-shaving operation is permitted. * For modelling purposes, peak operation of backup systems is reflected within demand response assumptions and not treated as a separate mitigation pathway.	Yes*
Waste heat reuse (including district heating)	Systems that capture low-grade thermal energy that would otherwise be released to the environment and redirect it for productive use. In a data centre context, this typically involves transferring server waste heat to nearby buildings through district energy networks.	Yes

Long-term innovation

These ventures have the most relevant and market-ready technologies.

Company	Category	Overview
Cascara Energy	Renewable energy	District energy solution that creates a highly efficient, passive HVAC system. Its technology reduces energy consumption from heating and cooling buildings by up to 70 percent and minimizes emissions and operational costs.
Cence Power	Energy efficiency	Centralized direct current (DC) power distribution systems for commercial LED lighting, telecom and data centres, enhancing electrical efficiency and reducing operational costs. Its systems can be used in both new builds and retrofit projects.
CoolIT Systems	Cooling	Direct liquid cooling (DLC) technology for AI and high-performance computing. DLC uses the exceptional thermal conductivity of liquid to provide dense, concentrated cooling to targeted areas. By using DLC and warm water, the dependence on fans and expensive air handling systems is drastically reduced.
Daanaa	Energy recovery	Scalable power transaction unit (PTU) technology is a programmable module that makes it simpler and more efficient to generate, store, distribute, consume and manage energy from any source. It enables original equipment manufacturers in solar power, energy storage, automotive, data centres and others to design energy-efficient systems and reduce engineering efforts, while reducing energy conversion losses and heat generation.
Enersion	Energy recovery	Enersion’s technology uses waste heat from liquid-cooled server loops to generate cooling for the data centre. This creates a self-reinforcing energy loop where the servers’ waste heat powers the cooling required to keep them running.
Extract Energy	Energy recovery	Extract Energy uses a proprietary multipoint laser technique and device capable of functioning as a super-efficient heat engine, which captures energy from abundant low-grade waste heat and converts it to clean electricity at low cost.

Company	Category	Overview
ThermaCity	Renewable energy	A construction company focused on providing comfortable, cost-friendly and low-carbon thermal storage solutions to various building types. Specializes in geothermal retrofits.
QScale	Cooling, renewable energy, energy recovery	Builds and operates high-density AI co-location facilities designed for large-scale training and inference. Powered by renewable energy, the infrastructure is engineered for liquid cooling and delivers unmatched efficiency and seamless scalability. The facilities utilize exclusive waste heat recovery systems to power greenhouses.

Additional companies for consideration include:

Company	Category
Accelsius	Cooling
Armstrong Fluid Technology	Cooling
Connect-X	Energy data
Eavor Technologies	Renewable energy
Edie Farming	Co-location
Ekstera	Energy recovery
Feedatum	Energy data
Hypertec	Cooling
Infinidium	Energy recovery
Morgan Solar	Renewable energy
Peak Power	Energy storage
Permalution	Water conservation
SHARC Energy Systems	Energy recovery
Systemex Energies	Cooling
vadiMAP	Energy data
Wafr Technologies	Water conservation, cooling
Xnrgy	Cooling
ZutaCore	Cooling