

Powering Canada's Compute

Infrastructure constraints and regional readiness for large-scale
AI and data-centre development in Canada

Raj Gandhi · September 2026

Companion dataset, source manifest and methodology: *canada_compute_regions.csv*, *source_manifest.csv*, *METHODOLOGY.md*

Playable model: powering-canadas-compute.raj-gandhi.workers.dev

Independent compilation from primary sources. Not reviewed or endorsed by any utility, regulator, or firm.

Executive summary

The question this brief answers is not whether Canada has enough electricity for AI — on paper, several provinces plainly do. It is whether a specific large compute load can actually be *connected*, on a developer's timeline, in a place with power that runs around the clock.

What was examined. Five provinces whose system operators publish large-load connection guidance — Quebec, Ontario, Alberta, British Columbia, Manitoba — on grid emissions intensity, the 2026 large-load connection process, and a categorical interconnection-access assessment; plus a seven-technology generation cost and performance spine.

What matters. Generation capacity, transmission, the interconnection process, land and network sit in series. A province can be strong on the first and still be effectively closed on the third.

What was found. In all five provinces, large-load grid connection in 2026 is **rationed**^{1,3,4,2,5} — through a selection process (Quebec), a competitive call (British Columbia), an interim allocation block that is already fully committed (Alberta), or a system study with no published duration (Ontario). Manitoba has the most near-term room, and a forecast capacity shortfall around 2029/30. How clean or how large the provincial grid is does not change this.

Where the bottlenecks are. Quebec: administrative access. Ontario: an unfinished framework and location-specific capacity. Alberta: an exhausted interim block, and the highest grid emissions of the five (438 vs 1.9–59 gCO₂e/kWh elsewhere)¹². British Columbia: a competitive call that demand already exceeds. Manitoba: a closing window.

Takeaway. For Canadian regions, winning large-scale compute is now mostly a question of connection policy and delivery speed, not of installed megawatts. The provinces that publish a clear, non-discretionary path to a firm large-load connection — with a defined timeline — will be the ones that get built in.

1. The infrastructure requirement

Large-scale AI is an infrastructure problem before it is a computing one. Global data-centre electricity consumption was roughly 415 TWh in 2024 and is projected near 945 TWh by 2030 — about 15% a year, with the AI-specific "accelerated server" share growing faster still¹³. The same analysis notes the asymmetry that defines the siting problem: a data centre can be built in roughly two to three years, while the transmission and generation to serve it routinely take longer.

There is no single published "minimum" for a hyperscale site. What the Canadian evidence does show is the scale at which connection becomes a distinct, managed process: Quebec applies a selection process above **5 MW**¹; Alberta's interim large-load framework is built around a **1,200 MW** block³; British Columbia's 2026 Call for Demand drew about **800 MW** of applications⁴. A useful screening question for the largest proposed developments is therefore not "is there enough power in the province" but "can this operator commit a firm block of this size, here, within the development window."

2. What actually constrains a site

Between a province's installed generation and an energized compute load sit five steps, in series. A weakness at any one of them stops the project.



This brief has primary-source data for the first three at the province level. Land and fibre matter and are named here, but standardized Canadian data for them was not sourced for this release (see Methodology, Limitations). The central point is structural: **a province being rich in clean generation tells you almost nothing about whether step three is open**. Every province examined has more than enough energy in aggregate; what varies is whether a new large load can get through the connection process, and how long that takes.

3. Canadian regional comparison

Five provinces, 2026. Grid GHG intensity is observed (ECCC)¹²; the connection description is quoted from each system operator; "Access" is this project's categorical assessment against a published three-part rubric (rationing mechanism, interim-block status, formal study process — see Methodology), not a queue-time measurement and deliberately not a 0–100 score.

Region	Grid GHG gCO ₂ e/kWh	Large-load connection in 2026	Access	Primary bottleneck
Quebec Hydro-Quebec · reg. vertically integrated utility	1.9	Data centres above 5 MW are subject to a selection process; Hydro-Quebec has proposed a dedicated large-data-centre rate near 13 cents/kWh, roughly double current large-power customers. ¹	HIGH	Administrative access: connection is allocated via a selection process, not available on demand.
Ontario IESO · reg. wholesale market with regulated distribution	59	IESO is developing specific technical and reliability requirements for large computational loads; connection feasibility is determined by a system study and is location-specific. ²	MODERATE-HIGH	Location-specific grid capacity and a system-study process with no published timeline.
Alberta AESO · dereg. energy-only wholesale market	438	AESO operates an interim Phase-1 large-load framework with a 1,200 MW connection block (970 MW Genesee/GLDC + 230 MW Keephills); the block is fully allocated and further large loads move to a subsequent connection phase. ³	MODERATE-HIGH	The interim large-load allocation is exhausted; Alberta also has the highest grid emissions of the five regions.
British Columbia BC Hydro · reg. vertically integrated utility	18	BC Hydro connects emerging-industry large loads through a competitive process; its 2026 Call for Demand received 15 applications representing roughly 800 MW. ⁴	MODERATE	Connections are rationed through a competitive call cycle and demand exceeds available awards.
Manitoba Manitoba Hydro · reg. vertically integrated utility	2.5	Connection capability is assessed project by project; Manitoba Hydro's Integrated Resource Plan context projects that peak demand will exceed capacity around 2029/30 and identifies roughly 1,760 MW of additional capacity needed by 2035. ⁵	MODERATE	A provincial capacity shortfall is forecast for around 2029/30 - near-term room but a closing window.

The finding in one line: access is rationed in all five — independent of how clean (Quebec 1.9, Manitoba 2.5, BC 18 gCO₂e/kWh) or how carbon-heavy (Alberta 438) the grid is.

How the Access column is assigned. Three questions, applied to each operator's own published material. (1) *Rationing* — is a large load connected on request, or allocated by a selection process or competitive call? (2) *Interim block* — is there a published interim large-load capacity block, and is it still open or exhausted? (3) *Study process* — does a multi-year system study with no published duration stand in the way? **HIGH** = allocated by selection, not on request. **MODERATE-HIGH** = an unbounded study, or an exhausted interim block. **MODERATE** = a competitive call cycle, or near-term room with a closing window. Two reviewers applying this to the same sources should reach the same labels; a 0–100 score would not survive that test.

4. Power economics

If a region needs *new* generation to host compute, the cost and speed of that generation become the constraint. The table below is the CER's own benchmark cost table, paired with 2025 empirical capacity factors and reference lead times.

Technology	Overnight capex \$/kW	Fixed O&M \$/kW-yr	Capacity factor	Ref. lead time (yr)	Lifecycle GHG gCO ₂ e/kWh	Capex per avg-MW delivered (derived)
Natural gas combined cycle	1,450	50	58%	3	423	2,483
Utility-scale solar PV (variable)	1,700	39	24%	2*	48	6,967
Onshore wind (variable)	1,900	72	34%	3	11	5,556
Natural gas combined cycle + CCS	3,705	110	58%	3	106	6,344
Large hydro (>100 MW)	4,500	51	35%	4	24	12,748

Geothermal	7,100	137	66%	4	38	10,774
Small modular reactor	9,262	63	91%	6	12	10,178

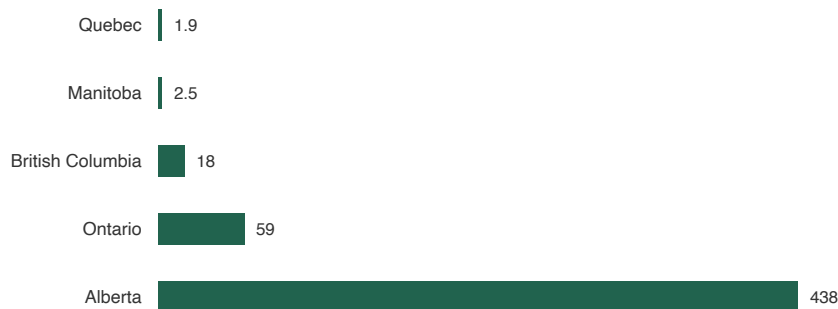
Overnight capex and fixed O&M: CER Canada Energy Future 2023, Electricity Supply Model, Table E.1, verified exact against the live page⁶. Capacity factor: 2025 U.S. EIA empirical utility-scale proxy^{7,8}. Reference lead time: U.S. EIA AEO2023 reference plants⁹ (* solar: illustrative planning value, not in that source). Lifecycle GHG: NETL 2025 for gas¹⁰, harmonized NREL/IPCC literature midpoints for the rest¹¹. **Capex per average-MW delivered** = overnight capex ÷ capacity factor; it normalizes for how much of the year a plant runs but not for firmness — a 24%-factor plant is not equivalent to a 91%-factor plant for a load that must run continuously.

Two implications hold up under the sourcing:

- **Nameplate cost misleads.** Solar has the second-lowest overnight cost (\$1,700/kW) but, at a 24% capacity factor, the second-highest cost per average megawatt actually delivered (\$6,967/kW-equivalent) — and it delivers none of that on a fixed schedule. Firm options (gas, hydro, geothermal, SMR) are what a 24/7 load can actually plan around.
- **Firm and clean and fast is the hard combination.** Gas combined cycle is the cheapest firm option and buildable in ~3 years, but at ~423 gCO₂e/kWh lifecycle¹⁰. SMRs are firm and low-carbon but ~\$9,262/kW and a ~6-year reference lead time; OPG's Darlington program — four BWRX-300 units, ~1,200 MW, with Unit 1 reported near \$7.7B including contingency and capitalized interest¹⁴ — is the Canadian reality check on that timeline and cost.

This is why *connecting to an existing clean grid* is the strongly preferred path where the connection process allows it — and why §3's finding, that the process rarely does, is the core of the problem.

Grid GHG intensity by region



gCO₂e / kWh · ECCC 2026, Table 5.3

Alberta's grid is roughly **230×** more carbon-intensive per kWh than Quebec's. A compute load that connects to the existing grid inherits this number¹².

5. Regional profiles

Quebec

GRID Predominantly hydro; near-zero grid emissions, but capacity is directed by the utility. Consumption GHG intensity 1.9 gCO₂e/kWh (ECCC 2026)¹².

CONSTRAINT Large-load access is administratively rationed through a selection process rather than granted on request. Administrative access: connection is allocated via a selection process, not available on demand.¹

ASSESSMENT Interconnection access **HIGH**. Indicative timeline 4 years (scenario calibration, not a measured queue — Timeline figure is a disclosed scenario calibration anchored to the selection-process framing; it is not a measured queue time.)

WHAT WOULD CHANGE IT A published, non-discretionary connection tariff and capacity allocation above 5 MW would move access from HIGH toward MODERATE.

Ontario

GRID Mixed nuclear/hydro/gas grid; nuclear refurbishment programs compete for network capacity and capital. Consumption GHG intensity 59 gCO₂e/kWh (ECCC 2026)¹².

CONSTRAINT Large computational loads follow a formal system-study process; no province-wide queue duration is published. Location-specific grid capacity and a system-study process with no published timeline.²

ASSESSMENT Interconnection access **MODERATE-HIGH**. Indicative timeline 3 years (scenario calibration, not a measured queue — Timeline figure is a disclosed scenario calibration anchored to the system-study framing.)

WHAT WOULD CHANGE IT A completed large-computational-load technical framework with typical study durations published would remove the main uncertainty.

Alberta

GRID Gas-dominated grid; historically the fastest interconnection, but the highest emissions and an exhausted interim block. Consumption GHG intensity 438 gCO₂e/kWh (ECCC 2026)¹².

CONSTRAINT The interim 1,200 MW large-load block is fully allocated to two committed projects; new large loads enter Phase 2. The interim large-load allocation is exhausted; Alberta also has the highest grid emissions of the five regions.³

ASSESSMENT Interconnection access **MODERATE-HIGH**. Indicative timeline 3 years (scenario calibration, not a measured queue — Timeline figure is a disclosed scenario calibration; Phase-1 exhaustion argues against treating Alberta as reliably fastest.)

WHAT WOULD CHANGE IT A Phase-2 large-load framework with defined capacity, plus grid decarbonization, would address both the exhausted block and the emissions gap.

British Columbia

GRID Predominantly hydro; low grid emissions, but connection capacity is allocated by competitive selection. Consumption GHG intensity 18 gCO₂e/kWh (ECCC 2026)¹².

CONSTRAINT Large-load connections are rationed through a periodic competitive call; applications already exceed a single call's likely awards. Connections are rationed through a competitive call cycle and demand exceeds available awards.⁴

ASSESSMENT Interconnection access **MODERATE**. Indicative timeline 3 years (scenario calibration, not a measured queue — Timeline figure is a disclosed scenario calibration anchored to the competitive-call framing.)

WHAT WOULD CHANGE IT A larger or more frequent Call for Demand, or a standing connection process alongside it, would ease the rationing.

Manitoba

GRID Predominantly hydro; near-zero grid emissions and comparatively more headroom now than the other four. Consumption GHG intensity 2.5 gCO₂e/kWh (ECCC 2026)¹².

CONSTRAINT More near-term connection room than the other four regions today, but a capacity-addition need is approaching. A provincial capacity shortfall is forecast for around 2029/30 - near-term room but a closing window.⁵

ASSESSMENT Interconnection access **MODERATE**. Indicative timeline 2 years (scenario calibration, not a measured queue — Timeline figure is a disclosed scenario calibration anchored to a system with future rather than current capacity pressure.)

WHAT WOULD CHANGE IT Confirmed capacity additions ahead of the ~2029/30 shortfall would keep the current near-term room open.

6. The Canadian opportunity

Canada will not "win AI" by having clean power. Several jurisdictions have clean power. The conditions under which Canadian regions could actually attract large-scale compute investment are narrower and more specific:

- **A published, non-discretionary connection path.** Developers can work with a slow process if it is *legible*. A selection process with no stated criteria or timeline is worse for investment than a longer process that is defined.
- **A firm block commitment.** The provinces that can say "yes, X MW, at this node, energized by year Y" — and mean it — are the ones that get built in. Alberta's Phase-1 block did exactly this; the lesson of its exhaustion is that the next block needs to be defined before the first one fills, not after.
- **Clean firm supply, or a credible plan for it.** Quebec, BC and Manitoba have the grid; the question is allocation. Alberta has the speed and the market but an emissions gap that matters to hyperscaler procurement commitments.
- **Delivery credibility on new generation.** Where new firm supply is needed, the Site C and Darlington cost and schedule records are the benchmark a serious plan has to beat, or explain.

7. Implications

Policymakers & utilities: the binding constraint is connection-process design, not generation. A defined large-load framework — capacity, criteria, timeline — is the highest-leverage move, and it needs a successor block queued before the current one fills.

Developers & investors: screen on the connection process and its published timeline first; treat provincial generation totals as necessary but not informative. Alberta trades emissions for speed and market access; the hydro provinces trade a clean grid for administrative allocation.

Appendix: large compute site screening checklist

A one-page checklist that operationalizes §2's constraint chain. It is a screening tool for an early go / no-go, not a substitute for a location-specific utility study.

Dimension	Screening question	Green / amber / red signal
Power — block	Can the operator credibly commit a firm connection of the required size (MW) at a named node?	A defined framework with open capacity (green) → a study-by-study process (amber) → a selection process or an exhausted block (red).
Power — firmness	Is the supply firm 24/7, or does it depend on variable generation plus storage or backup not yet costed?	Existing firm grid or firm new build (green) → firm grid but allocation uncertain (amber) → relies on unbuilt firm supply (red).
Timeline	Is there a <i>published</i> typical connection duration, and does it fit the development window?	Published and fits (green) → unpublished but historically workable (amber) → no stated timeline (red).
Transmission	What network upgrades does the connecting utility say are required, and who pays?	Minor, cost known (green) → material, cost-share defined (amber) → major reinforcement, allocation unsettled (red).
Emissions	What is the grid's consumption GHG intensity, and does it meet the buyer's procurement commitments?	Below ~50 gCO ₂ e/kWh (green) → 50–150 (amber) → above ~150, or gas-backed behind the meter (red).
Land	Is there contiguous industrial land of the required size, zoned or readily rezonable, adjacent to the connection point?	Identified and controlled (green) → identified, not controlled (amber) → not identified (red).
Network	Are there at least two diverse long-haul fibre routes to the site?	Two or more, carrier-confirmed (green) → one plus a planned second (amber) → single route (red).
Cooling	What cooling design does the climate and water situation allow, and what is the resulting energy or water penalty?	Free-cooling viable, low water (green) → hybrid, defined water source (amber) → water-constrained watershed (red).
Permitting	What approvals are required beyond the connection, and what is the critical-path duration?	Standard industrial, <12 months (green) → environmental assessment triggered (amber) → contested or multi-jurisdiction (red).

Any red on Power, Timeline, or Land is usually decisive at the screening stage. Amber on several dimensions is a signal to commission the location-specific studies before committing capital.

Methodology & limitations

Full detail in *METHODOLOGY.md*. In brief: five provinces with a system operator that publishes large-load guidance; sources preferred in the order Canadian operators/regulators → Canadian federal statistics → intergovernmental analysis → U.S. government reference datasets (as documented benchmarks) → company filings. Every data value carries a source id; *claims.csv* maps each headline statement to its source and to one of **SOURCE** / **DERIVED** / **ASSESSMENT**.

What this is not: a forecast of demand, price, jobs, or investment; a project register; or a land/fibre/water study. Where a figure could not be sourced to a primary document, it is named as a limitation, not estimated.

Limitations. No energy or grid-planning professional has reviewed the assessments. Large-load connection frameworks in all five provinces are being actively rewritten in 2026; this is a dated snapshot. Grid intensity and connection process are province-level; a real project depends on a location-specific utility study. No standardized Canadian land, fibre, or water data is included. Lead times and capacity factors use U.S. EIA reference data as documented benchmarks, not Canadian forecasts; CER Table E.1 carries no stamped base year. The 2–4 year interconnection timelines are disclosed scenario calibration, not measured queue data.

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