

Data Centres, AI and Electrification – Legal and Corporate Approaches to Growing Power Demands in Canada

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I. INTRODUCTION

Data centre load growth is the single largest driver of forecast electricity demand growth in North America. Data centres are the physical backbone of the modern information society and the digital-services industry, and, as the number and scale of data centres has increased, so has their energy consumption. The advent of generative artificial intelligence (AI),¹ with its much greater computing power requirements, has turned an expansion into an explosion. Alberta and other Canadian jurisdictions are positioning themselves to attract data centre investment (and the associated jobs and tax revenue), leveraging their advantages of cooler ambient temperatures and reliable and inexpensive electricity potential.

Data centre load growth, however, is outpacing the electricity generation and transmission investment required to serve it. This is disrupting the electricity industry across North America and creating opportunities for investors in renewable, dispatchable and baseload generation; energy storage and demand response; and transmission. At the same time, the risks created by this pace of growth threaten to limit that growth. Long payback periods and unproven revenue streams introduce corresponding risks of overbuild and stranded costs. Behind-the-fence (BTF) generation raises concerns of uneconomic bypass of the transmission system, increasing costs for other transmission system customers. Adding large loads to strained grids and intermittent power sources in order to serve data centre load growth is also creating

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¹ AI can be generally defined as the science of making machines that are capable of learning to perform tasks traditionally considered to require human intelligence, normally by learning from data to find patterns, make predictions and perform actions, rather than rely explicitly on programmed instructions. Generative AI or “gen AI” refers to applications that focus on new content, text, images, audio and video including reasoning models.

reliability concerns which affect both household and industrial customers. Regulators and legislators across North America are exploring a variety of responses to these risks as they strive to attract data centre investment while promoting sustainable development and protecting existing customers.

Data centre load growth also introduces novel commercial considerations for stakeholders. Proponents seeking BTF generation will encounter the typical issues associated with generation project development, including load forecasting; counterparty credit assurances; schedule risk; and cost overrun risk. In addition, they will also be acutely aware of guaranteed availability rights, change of law risk, expansion rights, planned and unplanned outages, and force majeure issues. With electricity being the largest contributor to Scope 2 carbon emissions for data centres, operators are also increasingly entering into renewable Power Purchase Agreements (**PPAs**) and virtual PPAs (**VPPAs**) to offset their data centre carbon footprint. These operators will also be negotiating pricing structures (fixed price, indexed, discounts, floors/ceilings), environmental attributes (including who gets credit), and considering around-the-clock carbon free matching, in a manner that is specifically tailored to data centres. Proponents will need to consider the commercial aspects of power procurement that are unique to data centres, as well as their regulatory and public policy implications.

Each data centre project attracts unique energy-related considerations based on its location, jurisdiction, purpose, workload, commercial objectives of its proponent(s), and how it is proposed to be supplied with electricity. This paper attempts to provide an overview of key considerations for investors in data centres and the infrastructure required to supply them with electricity. In the sections that follow, we briefly set out the relevant facts about data centres and AI and their current respective load projections; discuss the opportunities and risks associated with supplying data centres with electricity and some of the legislative and regulatory responses seen to date; and comment on some of the commercial and project issues specific to data centres.

II. DATA CENTRES, AI, AND POWER ISSUES

A. What Are Data Centres?

While several concepts of what constitutes a data centre exist, there is no universally agreed upon definition. Data centres can generally be categorized by the types of users and the intended function, but the spectrum of these categories is broad and rapidly evolving.²

Generally speaking, a data centre is a facility that houses digital assets such as information technology (IT) equipment (such as servers, storage systems and networking equipment) that support AI, cloud services, cryptocurrency mining, and other data storage and generation. As the name suggests, data centres channel, process, manage and store the data we create, including business and customer data, financial records, personal data (such as photos and videos), as well as AI and “big data” produced by machine learning and generative AI (**gen AI**) (such as ChatGPT).

Data centres can be grouped into two broad categories:

1. **Enterprise Data Centres.** Enterprise data centres are private facilities that are owned and operated by a single organization to meet its own data processing and storage requirements. They can be customized to meet the organization’s specific processing and network requirements and sized to achieve economies of scale for the processes being conducted. They may be located on-site or off-site as best suits the organization, having regard for factors such as network connectivity, security, and the availability of power and cooling water. As proprietary facilities, enterprise data centres allow an organization maximum control over design and operations, which may be advantageous for ensuring privacy or redundancy or even necessary to meet certain regulatory requirements.³

² We note, for example, that AI model training and use can take place on laptops and smartphones or smart cars (known as “at the edge”) as well, but the larger AI models are too complex and are processed in data centres.

³ Mary Zhang, “Types of Data Centers: Enterprise, Colocation, Hyperscale” (26 November 2023), online: <dgtlinfra.com/types-of-data-centers>.

Large enterprise data centres are termed “hyperscale” data centres. They can occupy hundreds of thousands of square feet (or more) and house tens of thousands of servers. Most hyperscale data centres built to date provide computing, storage and networking resources to support large internet companies and cloud service providers such as Apple, AWS, Google, and Microsoft.

Enterprise Data Centres represent approximately 28% of data centre capacity today, but this has decreased from 85% in 2005, and hyperscale data centres represent approximately 37% of data centre capacity, an increase from 10% in 2010.⁴

- 2. Multi-tenant Data Centres.** Multi-tenant data centres (also termed “co-located data centres”)⁵ are used by multiple organizations and are often run by a separate operator. These facilities house IT infrastructure and the associated power, cooling, and network equipment and lease space and equipment to tenants. They offer organizations access to data centre capabilities without the capital and internal expertise required for an enterprise solution and can allow for rapid scaling through the lease of additional space.⁶ Multi-tenant Data Centres represent approximately 36% of data centre capacity today.⁷

The ultimate end user of power at a data centre is typically the entity with direct control of, and commercial interest in, the required power load and the timing of their data centre operation’s development and expansion. The end user may also have an interest in claiming credit for the facility’s renewable energy use towards their corporate sustainability goals. Both control and credit may be more complicated for multi-tenant data centres, however, especially where the tenants have different energy requirements and power consumption profiles than the operator that procures the power.

⁴ International Energy Agency (IEA), “Energy and AI” (April 2025) at 51-52, online: <[iea.org/reports/energy-and-ai](https://www.iea.org/reports/energy-and-ai)>.

⁵ In this paper, the term “multi-tenant data centres” is used to avoid confusion with co-location of generation.

⁶ Zhang, *supra* note 3.

⁷ IEA, “Energy And AI”, *supra* note 4 at 52.

B. Power Demand Considerations

Data centre demand for electricity is driven mainly by two processes: computing and cooling.⁸ Data centres contain high-performance computers tasked with processing massive amounts of data – especially those associated with machine learning and gen AI. The servers that process and store data may be equipped with central processing units (CPU) and more energy intensive graphics processing units (GPU). Servers account for approximately 60% of electricity demand in modern data centres, although this varies widely, with more efficient hyperscale data centres using nearly 80% of electricity demand for servers and IT equipment.⁹

These computing processes also produce a significant amount of heat,¹⁰ requiring efficient cooling to mitigate the risk of hardware damage and to maintain operation continuity. Cooling methods used by AI-driven data centres range from traditional air cooling (chilled air circulated through the computing system) to more advanced liquid cooling systems that use water or other coolants to absorb heat from the operating hardware.¹¹ Cooling may drive up to 40% of a data centre’s energy consumption.¹² Innovations in cooling processes, however, offer an ongoing opportunity to improve efficiency and sustainability.¹³ It also provides an opportunity for passive efficiency gains, by taking advantage of natural cooling in areas with relatively low ambient temperatures.¹⁴

⁸ IEA, “Electricity 2024: Analysis and Forecast to 2026 report” (January 2024), online: <[iea.org/reports/electricity-2024](https://www.iea.org/reports/electricity-2024)>.

⁹ IEA, “Energy and AI”, *supra* note 4 at 53.

¹⁰ While outside the scope of this paper, we note the opportunity to recover and use heat for industrial purposes and for district heating networks.

¹¹ While outside the scope of this paper, the water demands of AI data centres should be noted. While water usage varies significantly by data centre depending on the cooling technology, the local climate and the source of electricity, the IEA estimates that on average a 100MW hyperscale data centre in the United States consumes around 2 million litres of water per day in total—equivalent to about 6,500 households. See IEA, “Energy and AI”, *supra* note 4 at 242.

¹² U.S. Department of Energy, “DOE Announces \$40 Million for More Efficient Cooling for Data Centers” (9 May 2024), online: <[energy.gov/articles](https://www.energy.gov/articles)>.

¹³ IEA, “Energy and AI”, *supra* note 4 at 62; where technological advancements are projected to contribute significant reductions in data centre cooling requirements.

¹⁴ U.S. National Renewable Energy Laboratory (NREL), “NREL Joins \$40 Million Effort To Advance Data Center Cooling Efficiency” (14 December 2023), online: <[nrel.gov](https://www.nrel.gov)>.

In addition to servers and cooling, data centre use energy to maintain various levels of fail-safes to protect the core computing processes and prevent costly downtime.¹⁵

Data centres' electricity demand must be met reliably, to maximize uptime and reduce the likelihood of unplanned operational issues. Accordingly, data centres require a continuous power supply, often supported by redundant power systems to ensure continuity in the event of outages or maintenance. It is not uncommon for grid-connected data centres to have their own backup generation – a scenario that gives rise to several important policy issues and commercial considerations as discussed below.

C. Data Centres and AI

Starting in late 2022, breakthroughs in gen AI led to a boom in data centre construction. AI processes require many times the computing power – and therefore the electricity – of conventional applications. A conventional internet search, for instance, requires approximately 0.3 watt-hours (Wh), whereas a query using OpenAI's ChatGPT requires about 2.9 Wh – nearly ten times as much,¹⁶ and enough to run a light bulb for 20 minutes.¹⁷ Gen AI, which creates new content using patterns “learned” by reviewing enormous datasets, uses vastly more power: a gen AI-based query (or “**inference**”¹⁸) can consume up to 100 times as much electricity as a conventional internet search query,¹⁹ and training the large language models (**LLMs**) used in gen AI processes can consume over a gigawatt-hour (GWh) per training run²⁰ – enough electricity to power a small city for an hour.²¹

¹⁵ Steven Gonzalez Monserrate, “The Staggering Ecological Impacts of Computation and the Cloud” *The MIT Press* (14 February 2022), online: <thereader.mitpress.mit.edu>.

¹⁶ EPRI, “Powering Intelligence: Analyzing Artificial Intelligence and Data Center Energy Consumption” (28 May 2024) at 4, online: <epri.com>; see also Alex de Vries, “The Growing Energy Footprint of Artificial Intelligence” (2023) 7:3 *Joule* 586, online: <doi.org>.

¹⁷ Dara Kerr, “Artificial Intelligence’s Thirst for Electricity” *NPR* (10 July 2024), online: <npr.org>.

¹⁸ An inference is the process of a trained model analyzing data to generate outputs such as predictions, decisions or responses. Unlike training which involves learning from data, inference uses patterns to develop outputs. See IEA, “Energy and AI”, *supra* note 4.

¹⁹ IEA, “Electricity 2024”, *supra* note 8.

²⁰ de Vries, *supra* note 16 at 2191–2194.

²¹ Approximately 780,000 households consuming at the average 2021 Canadian household’s rate of 905 kilowatt-hours (kWh) per month (1.28 kWh per hour): Statistics Canada, “Household energy consumption, Canada and provinces” (19 March 2024), online: <statcan.gc.ca>.

Consequently, new AI data centres can consume between five and ten times as much power as conventional data centres.²² A typical AI-focused data centre may consume 100 MW, as much electricity as 100,000 households, but the largest may consume 20 times as much.²³ A significant portion of this power is used directly for data processing, which is employing increasing quantities (and densities) of powerful hardware. To increase data processing capacity, data centre servers are packed tightly and run continuously, which consequently generates even more heat. This makes effective cooling even more power intensive and critical in order to maintain operations and prevent hardware damage. Unlike many data centre functions, which often have variable workloads averaging 30% or 40% of total processing capacity, many AI processes, such as LLM training, can run at 100% capacity for weeks or months.²⁴ This distinguishes AI from applications like cryptocurrency mining, which is frequently run intermittently in order to take advantage of low power prices or currency fluctuations. The higher workload of an AI data centre, therefore, requires more robust and redundant data centre design, leading some operators to transition from traditional air-cooled facilities to higher-performance (and more energy-intensive) liquid cooling systems.²⁵ It is prompting others to consider locating data centres that require less frequent access (i.e., archival data storage) in relatively cold-climate areas (like Alberta), where natural ambient temperatures can help to reduce the cooling load.²⁶

Ultimately, AI data centres consume vastly more electricity, for more sustained periods, than alternative data centre usages, and generate significantly more heat which requires additional electricity for cooling. As gen AI becomes more sophisticated, and data centres become increasingly dense, the resulting energy usage is intensifying.

²² Laszlo von Lazar & Jim Doull, *2024 Electric Report*, at 18, online: <cdn.bfldr.com>.

²³ IEA, “Energy and AI”, *supra* note 4 at 13 and 38.

²⁴ Brian Martucci, “The 2025 outlook for data center cooling”, *Utility Dive* (22 January 2025) online: <utilitydive.com> quoting Steven Carlini, vice president of innovation and data centers at Schneider Electric.

²⁵ *Ibid* - noting recent announcements from [Meta](#) and multi-tenant provider [Equinix](#); National Renewable Energy Laboratory, “NREL Joins \$40 Million Effort to Advance Data Center Cooling Efficiency”, *NREL News* (27 March 2024), online: <nrel.gov>.

²⁶ *Ibid*.

D. Data Centre and AI-Driven Growth in Electricity Demand

Rapid growth in data centre load is a major contributor to forecast increases in electricity demand worldwide. According to the International Energy Agency (IEA), data centres (including both AI and cryptocurrency operations) globally consumed roughly 460 terawatt-hours (TWh) of electricity in 2022. This amount equates to approximately 71% of Canada's electricity generation in 2022,²⁷ or about 1.4-1.7% of world power consumption in that year. Data centres alone accounted for 415 TWh in 2024 or around 1.5% of the world's electricity consumption.²⁸ Growth in data centre electricity consumption has increased by approximately 12% per year since 2017, more than four times faster than the rate of total electricity consumption,²⁹ and this growth is expected to accelerate. The IEA forecasts that worldwide data centre electricity demand will more than double to 945 TWh, or around 3% of the world's electricity consumption, by 2030.³⁰ This growth is particularly evident in North America. In the United States, which accounts for the largest share of global data centre electricity consumption (45%),³¹ data centres accounted for 4.4% of all energy consumed in 2022 – more than double the figure in 2018 (1.9%) – and are forecasted to account for between 6.7 and 12.0% of consumption by 2028.³² In Canada, data centres accounted for approximately 1% of national electricity use in 2022 and this share is expected to rise rapidly, especially as AI adoption expands.³³ There are over 239 data centres operating in Canada as of 2024, led by Ontario (105), Quebec (57), British Columbia (35), and Alberta (22).³⁴

²⁷ Canada Energy Regulator, "Market Snapshot: Energy Demand from Data Centres is Steadily Increasing, and AI Development is a Significant Factor" (10 October 2024), online: <cer-rec.gc.ca>.

²⁸ IEA, "Energy and AI", *supra* note 4 at 14.

²⁹ *Ibid* at 14.

³⁰ *Ibid* at 63.

³¹ *Ibid* at 14

³² Arman Shehabi et al, *2024 United States Data Center Energy Usage Report* (Berkeley, California: Lawrence Berkeley National Laboratory, 2024) at 6, online: <eta-publications.lbl.gov>.

³³ Natural Resources Canada, "Data centres" (last modified 19 March 2025), online: <natural-resources.canada.ca>.

³⁴ Daniel Weeks, "Canada Prepares for Increased Electric Loads as Country Attracts Data Centres" *S&P Global* (2 October 2024), online: <spglobal.com>.

Data centres represent the single largest contributor to forecast growth in utility load forecasts, according to several analyses,³⁵ outpacing manufacturing and electrification, and could represent 44% of U.S. electricity load growth from 2023 to 2028.³⁶ This is complicating planners’ ability to forecast electricity load growth and properly invest in required resources. In its 2024 resource adequacy analysis, the Western Electricity Coordinating Council – the authority responsible for reliability planning in western Canada and the U.S.– found its “alarming” forecast increase in electricity demand between 2025 and 2034 to be driven by “[d]ata centers, manufacturing facilities, and to a lesser extent electrification”.³⁷

Of this growing data centre electricity consumption, AI seems to be a significant if not the preponderant component. While it is difficult to clearly distinguish between AI-related and non-AI related workloads performed at data centres in order to determine how much electricity demand comes from AI specifically, it is clear that AI is at the epicentre of the explosion of forecast data centre demand. Some high level estimates suggest that AI accounts for more than 24% of the server electricity demand and 15% of total data centre demand.³⁸ The IEA has forecasted that electricity demand from dedicated AI data centres will expand tenfold between 2023 and 2026, reaching 90 TWh – more than the country of Chile consumed in 2023³⁹ – and contributing one-seventh of total forecast data centre demand excluding cryptocurrency operations.⁴⁰ (Cryptocurrency mining was forecast to consume about 160 TWh in 2026.⁴¹)

Nevertheless, initial forecasts of the impact of AI on data centre electricity demand may be tempered by recent indications of various ways that AI can be made more efficient. In January 2025, it was announced that the DeepSeek LLM had been trained at a fraction of the cost and computing power required by

³⁵ John Wilson, Zach Zimmerman, & Rob Gramlich, “Strategic Industries Surging: Driving US Power Demand” (2024) at 12, online: <gridstrategiesllc.com/>; Maeghan Rouch et al, “Utilities Must Reinvent Themselves to Harness the AI-Driven Data Center Boom” *Bain & Company* (2025), online: <bain.com>.

³⁶ *Ibid.*

³⁷ Western Electricity Coordinating Council, *Western Assessment of Resource Adequacy (WARA)* (2024), online <feature.wecc.org/wara>.

³⁸ IEA, “Energy and AI”, *supra* note 4 at 56.

³⁹ Ember, *Yearly Electricity Data* (2024), online: <ember-energy.org>.

⁴⁰ IEA, “Energy and AI”, *supra* note 4 at 35.

⁴¹ *Ibid.*

competing LLMs. This gave rise to speculation that energy requirements for training LLMs could be greatly reduced without compromising output quality.⁴² However, subsequent review cast doubt on DeepSeek's apparent efficiency and found it to be offset by its tendency to generate significantly longer responses.⁴³ Forecasts of the impact of AI on data centre electricity demand may also be impacted as AI workload moves from data centres to end user devices (such as laptops, smartphones and cars) known as "the edge". Other technological improvements – such as low-power processors, AI Accelerators (hardware which can perform AI tasks quickly), photonic integrated circuits (that use light instead of electricity), task specific AI models, and quantum computing⁴⁴ – also have the potential to reduce electricity demand. However, improvements in either processes or technology will take time to flow through to project forecasts: in February 2025 American Electric Power's president and CEO was quoted as saying that the release of DeepSeek had not caused his utilities' data centre customers to change their development plans.⁴⁵ In other words, the broad spectrum of forecasted electricity demand attributed to data centres supporting AI workloads is further complicated by technological innovations and efficiencies, as well as uncertainties about AI adoption and usage patterns impacting electricity consumption. Ultimately, accurately forecasting electricity demand for data centres hosting AI workloads is exceedingly difficult, as the hardware, software, and operational practices involved rapidly evolve.

Concerns have also been raised that the recently-imposed U.S. tariffs could also dampen data centre growth forecasts. The tariffs have raised the costs of construction materials like steel and aluminum as well as data centre components like servers, transformers and cooling equipment. Some observers have noted that these

⁴² James Vincent, "The DeepSeek panic reveals an AI world ready to blow", *The Guardian* (28 January 2025), online: <theguardian.com>.

⁴³ James O'Donnell, "DeepSeek might not be such good news for energy after all" *MIT Technology Review* (31 January 2025), online: <technologyreview.com>. Salesforce has launched a standardized [AI Energy Score Leaderboard](#), with data from hundreds of AI models scored based on GPU Energy (Wh), and filtered based on model class as well as response type.

⁴⁴ IEA, "Energy and AI", *supra* note 4 at 69-70

⁴⁵ Ethan Howland, "AEP expects electric sales to jump 8.6% annually over 3 years" *Utility Dive* (18 February 2025), online: <utilitydive.com>.

cost pressures have contributed to project delays and increased capital expenditures⁴⁶ which have aggravated already strained energy equipment supply chains.⁴⁷ Tariffs are driving some tech firms to diversify their manufacturing and sourcing strategies to avoid some of the heaviest impacts⁴⁸ or to attempt to “onshore” their supply chains, despite the numerous challenges involved.⁴⁹ Larger industry participants appear to be taking this in stride: Meta has raised its 2025 data centre capex forecast partly in response to higher material and equipment costs caused by the tariffs.⁵⁰

These U.S. tariffs may drive some data centre investment away from the United States to jurisdictions like Canada where trade barriers remain relatively low. However, trade barriers are only one cost of doing business, and investors looking outside of the U.S. will likely consider other costs – such as corporate tax rates – and compare other potential destinations in holistic terms. At least one observer has raised concerns that rising costs caused by the tariffs could prompt even major data centre investors with an established Canadian presence to consider deploying their investment in lower-cost jurisdictions.⁵¹ On the other hand, the same observer suggests that Canadian companies with U.S. data centre operators could reduce their risk exposure by relocating those operations to Canada, citing, among other things, the relatively stable energy costs in some Canadian jurisdictions.

⁴⁶ Casey Weaver & Kateln Hilferty, “Data Centre Bytes” (1 May 2025) online, <morganlewis.com>; Brian Martucci, “Despite semiconductor exemption, Trump tariffs could chill US data center investment: analysts” (4 April 2025), online: <facilitiesdive.com>; Matt Vincent, “How Tariffs Could Impact Data Centers, AI, and Energy Amid Supply Chain Shifts” *Data Center Frontier* (3 April 2025), online: <datacenterfrontier.com>.

⁴⁷ The IEA estimates that supply chain constraints for key components like transformers and gas turbines could contribute to a delay in 20% of the data centre additions forecast for 2030. See IEA, “Energy and AI”, *supra* note 4 at 49.

⁴⁸ Billy Perrigo, “How Trump’s Tariffs Could Make AI Development More Expensive” *TIME* (April 8, 2025), online: <time.com>.

⁴⁹ Christian Davies et al, “Tech industry fears Donald Trump’s trade war will hamper US AI ‘dominance’” *Financial Times* (18 April 2025), online: <ft.com>.

⁵⁰ Sebastian Moss, “Meta raises AI data center capex forecast to up to \$72bn, blames Trump tariffs for increased cost” *DCD* (2 May 2025), online: <datacenterdynamics.com>.

⁵¹ Lance Mortlock & Pradeep Karpur, “Clouds On The Horizon: Analyzing Canada’s Data Centre Boom And Tariff Bust” *Chief Executive* (22 April 2025), online: <chiefexecutive.net>.

E. Siting Considerations for Data Centres

Siting a data centre will be informed by a wide range of factors. Every project is different, but siting analyses tend to converge on a few practical considerations, including rapid access to a reliable electricity source, low latency, proximity to users and urban centres (depending on workload), and land use limitations. Underlying these factors, and many others, are the regulatory, legal and political environments of the jurisdictions being considered. This section briefly outlines each of these considerations.

1. Access to Electricity and Time to Power

In today's market, the primary consideration for most developers of new data centres is "time to power", or the time required to obtain the electricity required to serve their facility, whether through a connection to the local electrical grid or a stand-alone generating unit. Timely access to electricity often determines a project's siting, economic viability and competitiveness.⁵² "Time to power" can be affected by factors ranging from the technical to the political, but the options available to a proponent in a given jurisdiction are fundamentally determined by the legislation and regulatory scheme.

An important consideration for developers during the siting process is whether to build their own power supply or to rely on grid power. It is becoming increasingly common for data centres to build their own dedicated power sources.⁵³ Building an onsite power source can reduce "time to power" by avoiding transmission connection queues, or by allowing a data centre to operate while it remains in a connection queue.⁵⁴ It can give a developer control over the source of its power and its carbon profile, while potentially offering additional income streams through the sale of excess power or renewable energy credits (both discussed below). A data centre that supplies most of its own power requirements can also reduce pressure

⁵² Centre for Strategic and International Studies (CSIS), "The Electricity Supply Bottleneck on U.S. AI Dominance" (3 March 2025), online: <csis.org>.

⁵³ PR Newswire, "Behind the Scenes: Developers Tackling the AI Data Center Dilemma" (23 October 2024) online: <prnewswire.com>.

⁵⁴ These benefits depend on onsite generation coming online in less time than a transmission connection. Recent developments, including backlogs for turbines and building materials and tariff-strained supply chains, have the potential to delay some generation projects considerably, potentially weakening the appeal of this approach.

on the grid, which is one of the factors that has prompted officials in Alberta (and in other jurisdictions) to suggest that big data centres “bring their own power”.⁵⁵

On the other hand, building onsite power requires a large incremental investment that may not be fully offset by avoided distribution costs. It may also be necessary to overbuild onsite generation considerably to provide the requisite degree of reliability in the absence of a grid connection. Building onsite power also requires careful attention to entity structuring, location, and regulatory approval, all of which are highly jurisdiction-specific considerations. In addition, the only reliable electricity sources that can be constructed in a timeframe that is concurrent with data centre construction timelines are solar PV and gas turbines.⁵⁶ Finally, since owning power assets is not normally within the preferred business model for AI data centres, developers may prefer to support new clean energy projects by acting as offtakers in corporate VPPAs, or by establishing a joint venture or partnership with a conventional power developer.

In addition to determining whether to build their own power or rely on grid power, data centre developers may also consider the carbon intensity of the power source in their procurement decisions. Access to renewable energy has historically been a priority for many data centre operators, both to reduce their carbon footprint and, through the use of fixed-price PPAs, to lock in low-cost power for the long term. Data centre investment has been noted to correlate to renewable PPA availability. According to the IEA, over 30% of the nearly 120 GW of operational renewable capacity procured globally has been procured by companies that operate data centres.⁵⁷ Conversely, as S&P Global recently noted, reduced availability of renewable PPAs in Alberta in 2024 made it more difficult for developers of large data centres to find green energy sources.⁵⁸ Notwithstanding these carbon reduction objectives, however, as access to extant generation becomes ever more constrained, data centre proponents have increasingly pursued “time to power” irrespective of immediate access to green electricity. For many of today’s developers, it may be enough for

⁵⁵ Chris Varcoe, “Varcoe: Alberta sizes up \$100B data centre opportunity, but says “bring your own electricity”” *Calgary Herald* (13 July 2024), online: <calgaryherald.com>.

⁵⁶ IEA, “Energy and AI”, *supra* note 4 at 79.

⁵⁷ *Ibid* at 77.

⁵⁸ Weeks, *supra* note 34.

a site to have the *potential* to accommodate renewable or low-carbon electricity, even if such a power source is not available at present.

2. *Latency*

In the data centre context, “latency” is the time taken for a packet of data to travel between two points across a network connection.⁵⁹ The data will normally travel between a local network, the ISP (internet service provider) network and then to the data centre for response. A network with high latency will have slower response times, which can negatively affect application performance, efficiency, and overall operational costs. The speed at which these data packets move across the network can be influenced by a number of variables, including internet infrastructure, bandwidth, data packet size, and network congestion, and, importantly for data centres, the geographic distance that data must travel and the medium across which it is travelling. Therefore, depending on the intended workload, data centre proponents may prefer to reduce or optimize the distance between the client initiating the request and the responding server or network of distributed servers. This can lead to clusters of AI data centres near metropolitan centres. Other data centre workloads, however, such as AI training workloads and certain kinds of AI inference work, do not require such proximity and so locational factors such as generation capacity, grid availability or congestion, and land access have greater importance than low latency. Similarly, if inference tasks can be conducted on user devices (laptops, phones, cars), known as “the edge”, rather than at centralized data centres, then latency (and power demand) can be distributed among the user base.⁶⁰ In that case, proximity to urban centres is not necessary. In any event, data centre sites should ideally have direct access to high-speed fiber-optic internet connections with minimal network devices like routers and network hops and a reliable power infrastructure.

⁵⁹ Michael Goodwin, “What is latency” *IBM* (15 August 2023) online: <ibm.com>.

⁶⁰ IEA, “Energy and AI”, *supra* note 4 at 72-74.

3. *Proximity to Users*

Proximity to users may be important for some types of data centre applications, but it is not always a primary consideration. While data centres require significant power sources, and often benefit from proximity to large urban centres due to their population density and network accessibility, certain AI-focused data centres, such as those focused on AI training, can be located far from major cities, even with minimal local fiber-optic initially, so long as developers can access abundant, low-cost power.⁶¹ As such, geography can be more flexible for AI training clusters and other workloads that are less latency sensitive. Urban centres will typically, and understandably, entail higher land costs and property taxes. This can increase projects' upfront investment requirements as well as the long-term operational costs. Rural locations, on the other hand, may offer more affordable land and lower tax burdens. These factors can make remote areas attractive options for certain types of data centre projects which need more space. Developers are increasingly willing to locate these types of power-hungry facilities in remote areas with cheap electricity.⁶²

4. *Land Use*

In addition to the typical land use and zoning issues associated with the development of commercial infrastructure, data centre developers must take into account the benefits and burdens of BTF generation (if being considered) and consider the associated geographic footprint. Land use and zoning restrictions will vary significantly depending on factors such as whether renewable or other types of generation facilities are also being installed. The physical footprint required will also vary considerably depending on the type of generation proposed by the data centre developer. For example, solar and wind generation facilities can require substantial land: approximately 7.9 acres/MW for solar and 2.5 acres/MW for wind. By contrast, other types of generation use less space: nuclear power plants, for instance, require on the order of 0.5 acres/MW, and small modular reactors (**SMR**) or microreactors can use much less still – 0.06 acres/MW,

⁶¹ Dan Rabb, “Lagging Data Center Construction in Canada May Be a Missed Opportunity” *BISNOW* (14 July 2024), online: <bisnow.com>.

⁶² Steve McLean, “Record growth continues in data centre sector: C&W” (18 September 2024), online: <renx.ca>.

according to one estimate.⁶³ Thus, the BTF generation technology selected will impact the siting and land use needs of the associated BTF and data centre facilities.

5. *Jurisdictional Considerations*

Provided siting criteria are met, the data centre industry is largely non-jurisdictional: given an adequate internet connection and sufficient land and resources, many data centre applications – including many AI applications – can be located almost anywhere. Conversely, electricity is highly jurisdictional, with local grids and generation being subject to regulation at the state or provincial level. This can give rise to a degree of competition between jurisdictions to attract data centre investment, as data centre proponents will examine differences in jurisdictions’ regulatory, legal and political environments as they relate to access to electricity (and other locally-regulated factors like land and water use, as well as conventional factors like tax and trade policy). The recently-imposed U.S. tariffs will shine an even brighter light on different jurisdictions’ approaches to data centres and the energy they require.⁶⁴ These differences can be significant. As discussed below, while most jurisdictions share the same kinds of concerns with avoiding stranded costs, uneconomic bypass of the grid and grid reliability, they are pursuing a wide range of policy, regulatory and legislative responses.

Given the relative lack of geographical constraints on many new data centre applications, incumbency may not confer much advantage in the race to attract investment. “Time to power” is emerging as the main jurisdictional consideration for many data centre projects, and the industry recognizes the savings in time and cost that can be realized from a strategic siting decision. As a result, businesses operating large data centres are expanding into unconventional locations beyond traditional data centre hubs, creating an

⁶³ Gabriel Soto et al, *Powering Data Centers with Clean Energy*, (Idaho: Idaho National Laboratory, June 2024) at 6, online: <gain.inl.gov>.

⁶⁴ Mortlock & Karpur, *supra* note 51.

incentive for jurisdictions eager to attract data centre investment to show that they can offer available, affordable, and accessible energy.⁶⁵

F. The Alberta Climate for Data Centre Investment

Alberta is one of many jurisdictions actively soliciting investment in data centres. It bills itself as uniquely positioned for successful data centre development due to its robust power generation capabilities, ample land and cool climate, abundant natural resources, streamlined regulations, affordable water and competitive tax rates.

In December of 2024, the Government of Alberta published its “AI Data Centre Strategy” promoting its competitive energy-only electricity market, which encourages private investment, as highly attractive to investors.⁶⁶ The strategy promotes both off-grid and grid-connected power solutions for data centres and touts Alberta’s abundant natural gas supply as a reliable means of scaling up new baseload power generation. Alberta has also highlighted its competitive power market structure, natural incentives for cost-savings, and a government committed to cutting red tape,⁶⁷ as well as its relatively low ambient temperature as a means of reducing energy consumption for cooling IT infrastructure, and its natural water resources as a source of chilled water heat absorption.⁶⁸

In December 2024, Alberta Technology and Innovation Minister Nate Glubish unveiled plans to attract \$100 billion worth of AI data centre infrastructure to the province over the next five years.⁶⁹ The province has created an “AI data centre concierge service” intended to “provide a direct gateway for investors and

⁶⁵ McKinsey & Company, “How data centers and the energy sector can satiate AI’s hunger for power” (17 September 2024), online: <mckinsey.com>.

⁶⁶ Alberta, Ministry of Technology and Innovation, *Alberta’s AI & Data Centre Strategy* (Edmonton: Government of Alberta, 2024), online: <open.alberta.ca>.

⁶⁷ *Ibid.*

⁶⁸ It has been estimated that, for each kilowatt hour of energy a data centre consumes, it would need two liters of water for cooling.

⁶⁹ Joel Dryden, “Alberta wants to build huge data centres for AI. That could bring a big emissions challenge” *CBC* (18 December 2024), online: <cbc.ca>.

operators entering Alberta’s market” and to “streamline pathways to partnerships” by connecting proponents and stakeholders with the relevant regulators and government actors.⁷⁰

Alberta’s efforts are bolstered by a Canadian federal government program to fund the development of AI and data centres (anywhere in Canada).⁷¹ The federal government has also been reported to be considering a \$15 billion incentive plan to attract investment in AI-focused, green-powered data centres to support the industry’s rapid expansion.⁷²

Interest in data centre investment in Alberta is expanding. As of the beginning of May 2025 the Alberta Electric System Operator (AESO) had 15 GW of data centre load in its connection queue, and multiple hyperscale data centre proposals have been advanced in the jurisdiction.⁷³ Like other jurisdictions, Alberta is recognizing the risks and opportunities of such proposals.

III. ELECTRICITY SUPPLY TO DATA CENTRES: RISKS AND OPPORTUNITIES

As data centres’ need for electricity continues to grow at a pace that outstrips investment in new generation and transmission infrastructure, legislators and regulators are grappling with both opportunity and risk. On one hand, proliferation of data centres offers economic benefits for jurisdictions ready to meet the resulting load demands; on the other hand, such proliferation threatens to strain existing energy systems and drive-up costs for other users. In response, various jurisdictions are exploring a range of policy mechanisms, some of which are canvassed below.

A. Data Centres Present an Opportunity for Generation and Transmission Investment

1. The Opportunity

As noted, the IEA estimates data centres’ worldwide electricity consumption could double between 2024 and 2030. In the United States – the location of half of data centres globally – data centre energy

⁷⁰ Alberta Government, “Build your AI data centre in Alberta” online: <alberta.ca>.

⁷¹ Government of Canada, “Canadian Sovereignty AI Compute Strategy” online: <ised-isde.canada.ca>.

⁷² Reuters, “Canada proposed \$15 bln incentive to boost AI green data centre investment, Globe and Mail reports” (12 December 2024), online: <reuters.com>.

⁷³ AESO, Connection Project List Dashboard, (May 2025): online: <aeso-portal.powerappsportals.com>.

consumption could account for as much as 9% of national electricity generation by 2030.⁷⁴ A 2025 estimate from Goldman Sachs anticipates global power demand from data centres will increase 50% by 2027, and by as much as 165% by 2030.⁷⁵ In Canada, utilities and system operators have begun factoring data centre demand estimates into their projections.⁷⁶

Canada's relatively cold climate, combined with its unique access to cheap and predominantly renewable energy and various national and regional incentives, has resulted in data centre project proponents looking to establish operations in this country. Ontario's system operator anticipates data centres will represent 13% of new electricity demand and 4% of the province's total demand by 2035.⁷⁷ Hydro Quebec has estimated a 25 TWh increase for Quebec's demand for the 2022-2032 period, 16% of which it has attributed to data centres.⁷⁸ In Alberta, over 15 GW of data centre load is in the AESO connection queue as of early May 2025, most of which is without its own generation, presenting large discrepancies in projected generation and load.⁷⁹

Meeting the growing power needs of data centres will require substantial investments in generation and transmission infrastructure. Goldman Sachs estimates up to \$720 billion will need to be invested globally through to 2030.⁸⁰ The wave of demand driven by data centres is estimated to drive peak demand growth at a rate of 3% per year, which would require up to six times the current pace of transmission infrastructure planning and construction to meet capacity.⁸¹ The massive infrastructure investment required to meet this forecast load demand is illustrated by the recent announcement of PJM Interconnection LLC – a regional

⁷⁴ Electric Power Research Institute, *Powering Intelligence: Analyzing Artificial Intelligence and Data Centre Energy Consumption* (Palo Alto: EPRI, May 2024) online: <epri.com>.

⁷⁵ Goldman Sachs, "AI to drive 165% increase in data centre power demand by 2030" (4 February 2025), online: <goldmansachs.com>.

⁷⁶ Canada Energy Regulator, *Market Snapshot: Energy Demand from Data Centres is Steadily Increasing, and AI Development is a Significant Factor* (Calgary: CER, October 2024) online: <vcer-rec.gc.ca>.

⁷⁷ IESO, "Electricity Demand in Ontario to Grow by 75 per cent by 2050" (16 October 2024), online: <ieso.ca>.

⁷⁸ *Ibid.*

⁷⁹ AESO, *Update on Data Centres* (Calgary: AESO, March 2025) online: <aeso.ca>; this does not include data centres located off-grid and supplying their own generation, as they do not follow the AESO's Connection Process.

⁸⁰ Goldman Sachs, *supra* note 75.

⁸¹ Wilson et al, *supra* note 35.

transmission organization responsible for transmission across 13 U.S. states – which approved a \$6.7 billion plan to upgrade its transmission systems, in large part to meet load demand driven by data centres.⁸²

As it currently stands, however, the power demand of data centres is outpacing the generation and transmission investment required to serve it, creating a fundamental constraint on data centre growth.⁸³ Part of this imbalance is due to the discrepancy in construction timelines between data centres and electricity infrastructure. The timeline for constructing data centres (~18-24 months) is much shorter than that for constructing new, or upgrading existing, generation and transmission grid infrastructure (from 3-10 years, depending on the project and jurisdiction).^{84,85} This discrepancy is expected to strain electricity systems and delay data centre project development. Such energy sector bottlenecks are also expected to factor significantly into developers' jurisdiction selection criteria.

Ironically, the global rush to build data centres has itself contributed to the delay in building generation and transmission facilities by causing shortages of key components (like high-capacity power transformers, switchgear, backup generators and cooling units) and extending procurement lead times.⁸⁶ As a result, data centre developers are confronted with urgent demands to build data centres to support AI, cloud and other rapidly emerging technologies, but must carefully stage procurement of equipment and often endure significant lag time to procure electrical gear and equipment. The lag time may be further aggravated by the aforementioned U.S. tariffs, which could extend the timelines for both data centres and supporting electrical infrastructure, as both depend to varying degrees on imported construction materials and specialized hardware.

⁸² PJM, “PJM Board Approves New Transmission Projects to Support Grid Reliability” (26 February 2025), online: <insidelines.pjm.com>.

⁸³ JLL, 2025 Global Data Centre Outlook (12 January 2025), online: <jll.com>.

⁸⁴ McKinsey & Company, *supra* note 66. Another author notes that gas and renewable energy projects typically take three to five years, while transmission projects can take seven to ten years to complete; Soto et al, *supra* note 63 at 6.

⁸⁵ IEA, “Energy and AI”, *supra* note 4 at 79; the IEA notes that the only reliable electricity sources that can be developed within the short timeframe aligned with data centre construction are solar and gas turbines.

⁸⁶ Steve McLean, “Record growth continues in data centre sector: C&W” (18 September 2024), online: <renx.ca>.

Lengthy connection queue wait times further contribute to the growing imbalance between surging data centre power demand and the ability of regional energy providers to deliver adequate supply. To connect to the grid, data centres and other large load customers must comply with interconnection processes established by the jurisdiction’s transmission system operator. These typically include impact studies to identify the infrastructure upgrades required to meet the requested load and allocate costs for such upgrades. The lag time between connection requests and energy deployment for projects is significant, and often takes several years before an applicant can be supplied with grid-sourced power.⁸⁷ The IEA’s analysis suggests that such grid constraints could delay around 20% of the global data centre capacity planned for construction by 2030.⁸⁸

Part of the lag is due in part to a recent trend of speculative load proposals being brought by large project proponents keen on securing their place in the interconnection queue. This has the effect of creating load estimates that may fail to materialize, exaggerating demand projections and obscuring utility connection processes. Standardizing the interconnection processes across jurisdictions may help alleviate these concerns, and efforts to this effect are underway in several jurisdictions,⁸⁹ including in Alberta *via* the AESO’s recent initiative to modernize the connection process for data centres.⁹⁰

In addition to connection process standardization, efficiency and coordination can offer some respite to these challenges. On the demand side, improvements in data centre efficiency, such as better server utilization, cooling technologies, and chip advancements can help mitigate data centres’ substantial power demands. According to the IEA, high-efficiency cooling technologies offer an opportunity to reduce data centre demand by 20%, while governments have also committed to collaborate in developing next-

⁸⁷ Joseph Rand et al, *Queued Up: 2024 Edition Characteristics of Power Plants Seeking Transmission Interconnection as of the End of 2023* (Berkeley: Berkeley Lab, April 2024), online: <emp.lbl.gov>; connection wait times in the U.S. are over 4 years and are expected to rise. However, at least one grid operator has announced plans to use AI to speed up its connection process; PJM Inside Lines, “PJM, Google & Tapestry Join Forces To Apply AI To Enhance Regional Planning, Generation Interconnection” (April 10, 2025), online: <insidelines.pjm.com>.

⁸⁸ IEA, “Energy and AI”, *supra* note 4 at 96.

⁸⁹ Peter Freed & Allison Clements, “How to reduce large load speculation? Standardize the interconnection process” (19 February 2025), online: <utilitydive.com>.

⁹⁰ AESO, *supra* note 79.

generation cooling tech.⁹¹ AI itself can also contribute to data centre efficiency, by using machine learning to optimize servers' reactions to different operating scenarios.⁹²

Another mitigating mechanism is increasing coordination between data centres and the grid within which they operate, referred to as a “shared economy model”.⁹³ This synergy between load and grid entails data centres transitioning from passive consumers to active partners in grid infrastructure, through, for example, supplying the grid with power from otherwise unused backup power sources, thereby contributing to the grid's reliability while also increasing affordability and sustainability for the data centre's operations,⁹⁴ or by data centres implementing operating flexibility frameworks (shifting or delaying workloads, timing use of back up generation) which reduce demand at critical times.⁹⁵ This type of partnership and collaboration will be essential to the efficient integration of data centre load.

It is apparent that the emerging need for timely and reliable energy for data centres presents a clear opportunity for investors in generation and transmission to help fill the infrastructure gap.

2. *Co-Located Generation*

Given the long lead times for grid interconnection and the importance of “time to power”, many data centre developers are pursuing co-location strategies in an effort to accelerate operations and ensure reliability of power supply. Co-located generation involves the strategic placement of energy generation facilities in direct proximity to a data centre or *vice versa*. Co-location can appeal to data centre proponents, as it offers enhanced reliability and greater autonomy over power quality and availability while reducing the risks associated with grid congestion or downstream system outages.

⁹¹ IEA, “Electricity 2024”, *supra* note 8 at 36; Alberta, Ministry of Technology and Innovation, *Alberta's AI & Data Centre Strategy* (Edmonton: Government of Alberta, 2024), online: <open.alberta.ca>.

⁹² IEA, “Electricity 2024”, *supra* note 8 at 36: the IEA notes Google's claim to have reduced the amount of energy used to cool its data centres by up to 40%; Richard Evans & Jim Gao, “DeepMind AI Reduces Google Data Centre Cooling Bill by 40%” *DeepMind* (20 July 2016), online: <deepmind.google>.

⁹³ IEA, “Electricity 2024”, *supra* note 8 at 22.

⁹⁴ *Ibid.*

⁹⁵ IEA, “Energy and AI”, *supra* note 4 at 100. The IEA notes that grid congestion usually occur during a limited number of hours per year, and reduction of grid demand by data centre operators less than 1% of the time would substantially improve grid stability and/or ability of the grid to accommodate new data centre integration.

Co-located generation can be either “behind the fence” (**BTF**, also termed “behind the meter” or BTM), or “outside the fence” (**OTF**, also termed “front of the meter” or FTM). In a BTF arrangement, the generation facility is integrated into the data centre operation and supplies power to the data centre exclusively. Where technically possible and permitted by law, BTF generators can also export unused surplus energy to the grid.⁹⁶ In Alberta, for instance, the law allows self-supplying market participants and designated industrial systems with internal electricity supplies to offer surplus electric energy into the electricity markets.⁹⁷ In an OTF arrangement, by contrast, the generating facility is not physically integrated with the data centre but is located nearby, supplying the data centre with a reliable source of power that is relatively free from the risk of grid congestion or downstream system outages.

As already noted, the Alberta government is promoting co-located BTF generation. Elsewhere in North America, long lead times for system investments required to meet the load requirements of data centres have led data centre proponents to construct BTF co-located generation on a temporary or staged basis pending the approval and construction of a transmission connection. Earlier this year, for example, Hyperscale Data Inc. announced an agreement with a Michigan natural gas utility to enhance its power capacity by 40MW through a behind the meter gas arrangement that could be brought on in 18 months pending a longer term 300 MW utility electrical upgrade anticipated to take 44 months.⁹⁸ In effect, the data

⁹⁶ In 2022 Alberta amended its electric utility legislation to make this more accessible, through the *Electricity Statutes (Modernizing Alberta’s Electricity Grid) Amendment Act*, SA 2022, c 8.

⁹⁷ *Electric Utilities Act*, SA 2003, c E-5.1 s 18(2) (“*EU Act*”); the *EU Act* requires all electric energy entering the interconnected electric system to be exchanged through the power pool. Exempt from this requirement is electric energy that satisfies the definition of “self-supply” (*EU Act*, s 2(1)(b)) and electric energy that the Commission has exempted from regulation, which may include energy produced by an industrial system designated under the *Hydro and Electric Energy Act*, RSA 2000, c H-16, s 4 for its own consumption (*EU Act*, ss 2(1)(d) and 117). The effect of these provisions is that BTF energy produced and consumed on-site by these consumers is exempt from regulation under the *EU Act*, while surplus energy may be offered into the markets. (At the time of writing, proposed amendments to the *EU Act* would replace references to the “power pool” with references to the real-time and the day-ahead markets contemplated as part of Alberta’s Restructured Energy Market: see Bill 52, *Energy and Utilities Statutes Amendment Act, 2025*, 1st Sess, 31st Leg, 2025. As of May 8, 2025, Bill 52 passed its third reading in the Legislative Assembly and is awaiting Royal Assent).

⁹⁸ Hyperscale Data, “Hyperscale Data Subsidiary Reaches Agreement in Principle to Add Capability for an Incremental 40 Megawatts to its Michigan Data Center, Boosting AI Infrastructure Development” *GlobeNewswire* (27 February 2025), online: <globenewswire.com>.

centre proponent invests in BTF generation to partially satisfy its “time to power” requirements and to mitigate the delay in connecting to the grid.

While co-located generation offers certain advantages for data centre proponents, it has raised or exacerbated questions regarding utility cost recovery and rate design. For instance, and as discussed further below, some applications of BTF can contribute to uneconomic bypass of the transmission system, foisting additional costs on utility ratepayers. Regulators in many jurisdictions are acting quickly to establish rules specific to data centres and other large load customers seeking to connect. In February 2025, the U.S. Federal Energy Regulatory Commission (**FERC**) commenced a proceeding to consider issues related to the co-location of large loads – particularly data centres – with generating facilities (the **FERC Co-Location Proceeding**).⁹⁹ Guidance from FERC is expected by the end of the year.

The FERC Co-Location Proceeding was announced amid, and in partial response to, debates among data centre developers, transmission operators, utilities, and customer advocates regarding cost allocation, access to grid services, grid reliability, and unduly discriminatory rates – some of which issues are discussed further below. The outcome of that proceeding will play a large role in shaping the future treatment of co-location arrangements within FERC’s jurisdiction and likely beyond. In Alberta, the AESO is participating in various analyses and initiatives to assess and address the impacts of large loads on the electricity grid¹⁰⁰ and is likely monitoring the FERC Co-Location Proceeding with interest.

3. *Need for Reliable Power Generation*

AI data centres are frequently characterized by a 24/7 demand for power. A central factor in their siting, if not the most important factor, is the availability of a constant and reliable source of electricity. While some data centre operations invest in on-site generation, most still rely on the grid for redundancy, in order to ensure reliable electricity supply at times of peak load, as backup during maintenance of on-site generation

⁹⁹ Federal Energy Regulatory Commission, *Order Instituting Proceeding Under Section 206 of the Federal Power Act and Consolidating with Other Proceedings*, Docket No EL25-49-000 (20 February 2025), online: <ferc.gov>.

¹⁰⁰ AESO, *2025 Long-Term Transmission Plan* (January 2025) at 8, online: <aeso.ca>.

facilities, or in emergencies. Finding a grid with the right mix of energy sources to deliver uninterrupted power that data centres require to support AI will be of primary importance. According to the IEA, renewables and natural gas currently “take the lead” in meeting data centre electricity demand but a range of sources are also poised to contribute.¹⁰¹

As global demand for electricity grows, natural gas power plants in particular are being relied upon as a timely deployable and dependable energy source to either self-supply data centres completely, or as a backup.¹⁰² Notwithstanding the renewable energy aspirations of data centre proponents and their users, therefore, there is a continued and increasing reliance on natural gas fired electricity generation. Indeed, the availability of natural gas generation is central to Alberta’s AI Data Centre Strategy, which touts it as a proven and cost-effective source of energy.¹⁰³ Likewise in the U.S., data centre operators are looking to natural gas generation as a reliable and timely option to meet surging energy demand.¹⁰⁴ Meta, for instance, is building a \$5 billion data centre project in Louisiana that will require a 2,300 MW expansion in natural gas power.¹⁰⁵ Perhaps most illustrative of data centre power demand being met by natural gas, however, is the recent \$10 billion repurposing of a retired Pennsylvania coal plant into the largest U.S. natural gas-powered plant intended to serve a data centre campus (as well as thousands of grid-connected residences).¹⁰⁶

There is also opportunity for other dispatchable sources of electricity. Data centre demand presents a lifeline for aging nuclear facilities as well as an opportunity for small modular reactors (**SMR**).¹⁰⁷ Nuclear reactors, including SMRs, offer stable and carbon-free power, which aligns with data centres’ demand for around-

¹⁰¹ IEA, “Energy and AI”, *supra* note 4 at 14.

¹⁰² Valerie Volcovici & Laila Kearney, “Data-center reliance on fossil fuels may delay clean-energy transition” (26 November 2024), online: <reuters.com>.

¹⁰³ Alberta, Ministry of Technology and Innovation, *Alberta’s AI & Data Centre Strategy* (Edmonton: Government of Alberta, 2024) at 7, online: <open.alberta.ca>.

¹⁰⁴ Centre for Strategic and International Studies (CSIS), “The Electricity Supply Bottleneck on U.S. AI Dominance” (3 March 2025) at 7, online: <csis.org>.

¹⁰⁵ Jeffrey Tomich, “Meta goes all in on gas to power a mega data centre” (21 November 2024), online: *Politico* <enews.net>; Nextera Energy and GE Vernova are also developing gas fired power generation in the US to meet data centre electricity demand.

¹⁰⁶ Business Wire, “Homer City Redevelopment and Kiewit Announce Country’s Largest Natural Gas-Powered Data Center Campus to Support AI and HPC Demand” (2 April 2025), online: <businesswire.com>.

¹⁰⁷ In the IEA base case forecast it is estimated that the share of nuclear in the data centre electricity mix will range from 16% to 18% between 2030 and 2035. See IEA, “Energy and AI”, *supra* note 4 at 92.

the-clock and sustainable power. From the perspective of a data centre proponent, the consistency of a nuclear power plant's output may represent an advantage relative to intermittent renewables. SMRs in particular, have a power capacity of up to 300 MW, are compact and modular (i.e., scalable), and can be transported for on-site installation. They offer consistent baseload generation to match constant load requirements, as well as low carbon emissions.

In response to the increasing demand for reliable and relatively clean energy, including to power data centres, government policies are changing to make nuclear energy more accessible. The trend towards nuclear power generation is particularly gaining momentum in the U.S.,¹⁰⁸ specifically as a source of electricity for data centres. Tech giants have expressly committed to tripling nuclear capacity by 2050,¹⁰⁹ and some have partnered with developers to accelerate deployment of SMRs to help meet the demand driven by data centres.¹¹⁰ In late 2024 Constellation Energy announced it will reopen the Three Mile Island nuclear power plant in a deal with Microsoft to power its cloud computing and artificial intelligence program.¹¹¹ Another proposal would see the Susquehanna nuclear power plant in Pennsylvania supply a co-located data centre, although the terms of the project's interconnection to the PJM grid continue to be considered by FERC.¹¹² These industry efforts mirror the American federal government policy, including recent steps to promote the development of uranium resources and SMRs through the creation of the National Energy Dominance Council.¹¹³

Nuclear energy and SMRs are also being encouraged in Canada. The federal government has recognized nuclear energy as a key part in the country's energy supply and recently announced major investments to

¹⁰⁸ Currently there are plans to build up to 25 GW of SMR capacity associated with data centre demand worldwide, with almost all announced projects in the United States. See IEA, "Energy and AI" *supra* note 4 at 76.

¹⁰⁹ World Nuclear Association, *Large Energy Users Pledge* (2024), online: <worldnuclear.org>.

¹¹⁰ X-energy, "X-energy Closes Upsized \$700 Million Series C-1 Financing Round to Accelerate the Development of Advanced Small Modular Nuclear Technology" (6 February 2025), online: <x-energy.com>.

¹¹¹ Constellation, "Constellation to Launch Crane Clean Energy Center, Restoring Jobs and Carbon-Free Power to The Grid" (20 September 2024), online: <constellationenergy.com>.

¹¹² Ethan Howland, "FERC rejects interconnection pact for Talen-Amazon data center deal at nuclear plant" *Utility Dive* (4 November 2024), online: <utilitydive.com>. An appeal of FERC's decision has been stayed pending re-hearing.

¹¹³ The White House, "Establishing the National Energy Dominance Council, Executive Order" (14 February 2025), online <whitehouse.gov>.

advance next-generation nuclear energy, including financial support for the development of SMRs.¹¹⁴ Alberta and Saskatchewan have signed a memorandum of understanding agreeing to collaborate on advancing nuclear power generation to support both provinces' electricity grids,¹¹⁵ and in 2022 the governments of Ontario, Saskatchewan, New Brunswick and Alberta collaborated on a joint strategic plan outlining the path forward for SMRs and key provincial priorities to this end.¹¹⁶ Policy is beginning to translate into practice: following a 2.5-year regulatory process, in April 2025 the Canadian Nuclear Safety Commission approved the construction of the first commercial SMR in Canada, a 300-MW reactor at Ontario Power Generation's Darlington site in Clarington, Ontario.¹¹⁷

While nuclear energy offers a promising solution for meeting the novel data centre power demand, several obstacles remain. High cost (relative to other low-emission technologies like carbon capture-equipped natural gas), lengthy timeframes for regulatory approvals, supply-chain challenges, and issues related to the management of nuclear waste continue to impede expedited adoption of nuclear energy.¹¹⁸ Development times also remain very long. In the United States, nuclear plant construction times range from three to ten years over and above regulatory approval processes. Modularized technologies like SMRs and microreactors have the potential to improve construction learning rates and may reduce construction times, however, the expected construction time for SMRs, estimated as 55 months,¹¹⁹ is still considered lengthy in the context of rapid data centre development. Technological evolution and policy change are thus helping to position nuclear generation as a potential option for data centre supply over the longer term at least.

¹¹⁴ Government of Canada, "Canada Invests in the Next Generation of Canadian-Made, Clean, Affordable Nuclear Energy" (5 March 2025), online: <Canada.ca>.

¹¹⁵ Saskatchewan Government, "Saskatchewan and Alberta Partner to Advance Nuclear Power Generation" (2 May 2024), online: <canada.ca>.

¹¹⁶ Government of Ontario, "A strategic plan for the deployment of small modular reactors" (2 March 2022), online: <ontario.ca>.

¹¹⁷ Government of Canada, "Decision by the Commission to authorize Ontario Power Generation Inc. to construct 1 BWRX-300 reactor at the Darlington New Nuclear Project site" (4 April 2025), online: <canada.ca>.

¹¹⁸ JLL "Is nuclear a viable power solution for data centers?" online: <jll.ca>; NESCOE, *Data Centres and the Power System, A Primer* (Calgary: NESCOE, 5 June 2024), online: <nescoe.com/>.

¹¹⁹ Soto et al, *supra* note 63 at 6.

Because of the need for constant and reliable electricity supply, data centres also rely on added redundancy. Data centre operators will often look to traditional sources of redundancy for such backup supply. Combustion turbines can be installed relatively quickly and are fuel flexible, but their lengthy start-up times typically make them better suited as backups for longer-term uninterruptable power supply or battery systems.¹²⁰ Fuel cells have also been adopted for data centres:¹²¹ their discharge profile can be made to match the steady electrical load of the typical data centre. Energy storage systems including flow batteries, thermal energy storage, pumped storage hydro electric power, compressed air, hydrogen and gravity storage technologies, and battery energy storage systems (**BESS**) can also be ideal for systems that need brief generation backup while they shift data and network traffic to other locations when an outage occurs.

In summary, data centre requirements for reliable power generation have not only incentivized investments in traditional dispatchable generation, such as natural gas, but have also stimulated investment opportunities in innovative nuclear and SMR supply and a broader array of redundant power sources.

4. *Net-Zero Objectives*

Many data centre proponents, or their users, have zero-emissions or sustainability objectives that encourage them to power their facilities using renewable energy or to otherwise reduce or offset their energy-related emissions.¹²² For example, Meta and Google have both expressed commitments to building energy-efficient and decarbonization initiatives to supplement their data centre operations.¹²³

In the drive to quickly secure access to reliable generation for data centres, sustainability objectives may be relegated to secondary considerations. In the words of one energy executive, “The decarbonization discussion ... isn’t driving the decision-making [around data centre siting]. It’s speed”.¹²⁴ However, some

¹²⁰ HDR, “Rethinking Data Centre Power: Overcoming Data Center Power Interconnection Challenges” (8 May 2023) online: <hdrinc.com>.

¹²¹ *Ibid.*

¹²² Ethan Howland, “Duke to offer expanded suite of clean energy options to Amazon, Google, other large customers” (30 May 2024), online: <utilitydive.com>.

¹²³ Meta, “Sustainability at Meta Data Centers” (2024), online: <datacenters.atmeta.com>; Google, “Operating Sustainably” (2024), online: *Google* <datacenters.google>.

¹²⁴ Dryden, *supra* note 70 quoting John Kousinouris, CEO of TransAlta Corporation.

jurisdictions are considering data centre-specific emissions standards or net-zero mandates, which would make net-zero operations a regulatory requirement in those jurisdictions, rather than a voluntary or aspirational goal.¹²⁵ In this sense, voluntary and regulatory net zero objectives associated with data centres are creating further opportunities for renewable generation in many jurisdictions.

The decreasing cost of renewable energy infrastructure, especially solar photovoltaic systems, has made it increasingly possible for industrial customers like data centres to access renewable sources of electricity. This can be done directly or indirectly. While locating next to a solar or wind facility is difficult in most instances, theoretically, direct access merely requires a physical link between the data centre and a renewable generation facility, such as a solar or wind plant, located on- or off-site. This link may be supplemented with a BESS to help manage variability and reliability.¹²⁶ A BESS can allow a data centre to store surplus energy at times when generation outpaces the data centre's demand and to supply it back to the data centre at times of higher system demand, or, for grid-connected data centres, to sell it into the market. The inclusion of a BESS in a data centre design and operations can offer numerous benefits to a data centre owner, including additional reserve power and decreased reliance on traditional grids, reduced need for backup generation to compensate for intermittent resources, and financial opportunity in selling surplus electricity and providing grid services.¹²⁷

Data centres that do not directly access renewable energy can access it indirectly through mechanisms such as PPAs. These mechanisms give data centre proponents greater control over their supply mix than they otherwise would have by simply connecting to the grid. Currently, technology companies operating data centres account for over 30% of the 120GW of operational renewables capacity that has been procured

¹²⁵ See section C(1) below for low-emission initiatives being adopted by some jurisdictions.

¹²⁶ A BESS is a battery that stores electricity sourced variously from the grid or from an on-site generation facility (frequently renewable generation) and is configured to supply that energy either to the data centre or to the grid, depending on the financial, environmental, or reliability motives of the participant. Patrick Donovan, *Understanding BESS: Battery Energy Storage Systems for Data Centres*, (Calgary: Schneider Electric, 2024) at 2, online: <schneider-electric.com>.

¹²⁷ *Ibid* at 7.

through corporate PPAs globally, and in 2024 this would be sufficient to cover 20% of the global electricity demand from data centres.¹²⁸

Whether data centre proponents and their users access renewable electricity directly or indirectly, they generally seek the benefits of renewable energy certificates (**RECs**). RECs are a type of carbon offset tied to renewable electricity generation. A typical REC represents 1 megawatt-hour (MWh) of electricity produced from a renewable source. RECs allow data centres to support their carbon-reduction goals even if they are not engaged in renewable generation themselves. RECs are traded in jurisdictional carbon markets, and their prices are influenced by the supply and demand forces of the particular carbon market.

Technological advances have also made it possible to reduce emissions from non-renewable energy sources like natural gas, using techniques like carbon capture and storage (**CCS**). A full discussion of CCS is beyond the scope of this paper, but it is germane that the technology has the support of both the federal and several provincial governments (including Alberta's) and has been put forward by Alberta's Technology and Innovation Minister as an option for data centre proponents seeking to achieve net-zero natural gas.¹²⁹ At present, CCS implementation has been limited, including in Alberta. However, the technology's availability, along with appropriate geology and technical expertise (as in Alberta), could be enough to satisfy data centre proponents in search of rapid access to cheap energy that emissions can be managed in future.

Generally, the advent of data centres, which are subject to voluntary or regulatory carbon reduction targets, has prompted additional interest in renewable energy generation, battery storage systems, PPAs, carbon credits and CCS, as proponents evaluate the quality, as well as the availability, of their required electricity.

B. Risks Associated with Investment in Data Centre Energy Supply

While data centre load expectations are providing opportunities for investment in new and innovative generation and transmission infrastructure, co-located generation and net-zero-oriented generation, there

¹²⁸ IEA, "Energy and AI", *supra* note 4 at 77

¹²⁹ Dryden, *supra* note 69.

are also significant risks associated with these new investments. The following sections discuss important risks presented by the need to supply data centres with energy and outline some of the legislative and regulatory responses that have been proposed and adopted to date.

The need for new generation and transmission infrastructure to supply forecasted data centre demand raises important questions regarding the allocation of the cost and risk associated with that infrastructure. New generation and transmission could, in theory, benefit all utility customers through increased capacity and reliability. However, those benefits are often contingent on the location of new generation, transmission and large load infrastructure and on the demand that new system infrastructure is intended to serve actually materializing. If these factors are not carefully considered and balanced in siting decisions and utility rate designs, the costs to customers of new system infrastructure required to serve data centres could be out of all proportion to the benefits they receive. Rising customer costs could limit data centre demand growth and spur legislative and regulatory efforts to protect customers from data centre-driven infrastructure costs. Some studies suggest that American ratepayers are already footing the bill for electrical infrastructure constructed to serve data centres.¹³⁰ This has sparked discussions on whether customers should be ring-fenced from data centre-driven infrastructure costs.¹³¹

1. Stranded Costs

As utilities, regulators, and investors scramble to respond to the unprecedented surge in forecasted load growth from data centres, concerns are mounting over the risk of overbuilding grid infrastructure that may later prove to be underutilized. This presents the potential for stranded costs, where capital investments into electricity infrastructure – with long payback periods – cannot be recovered through anticipated usages or revenues, leaving incumbent ratepayers exposed to high bills to recover the costs. The risk of stranded costs stems from the scale and uncertain longevity of data centre load.

¹³⁰ Cathy Kunkel, “Data centers drive buildout of gas power plants and pipelines in the Southeast” *IEEFA* (29 January 2025), online: <ieefa.org>.

¹³¹ Abraham Silverman, Suzanne Glatz & Mahala Lahvis, “Can regulators protect small customers from rising transmission costs for big data centers?” *Utility Dive* (11 December 2024), online: <utilitydive.com>.

Investments in new power generation and transmission needed to serve massive new loads like those associated with data centres often require billions of dollars in capital with decades-long timelines for recovering the costs. The FERC Co-location Proceeding is focused in part on appropriate cost allocation rules for co-located data centres.¹³² Absent clear and fair cost allocation rules, data centres may avoid paying for transmission services they benefit from, undermining cost causation principles and leaving existing customers to absorb the costs.

The risk of stranded costs is also founded in concerns that the AI power demand could be a “bubble”, whereby investment in AI-driven data centre investment outstrips the actual eventual market demand.¹³³ In this case, the costs of the resulting oversupply of electricity generation along with the underlying infrastructure costs would be borne by continuing customers. This risk is exacerbated by the lag time associated with infrastructure upgrades driven by speculative data centre demand, as today’s major investment decisions may need to be made with a level of uncertainty as to whether the data centre demand driving the investment will remain years in the future when the infrastructure becomes operational. Any discrepancy in demand projections for data centres and the long-term timelines for the infrastructure upgrades required to power them raises the risk that utilities and ratepayers could be left with the bill for stranded costs if demand growth fails to materialize to the extent projected.

To date, approaches to mitigating the risk of stranded costs associated with data centre-driven utility investment have focused on requiring project proponents to pay more of the costs of the infrastructure required to serve them, and to pay more of it up front. For instance, FERC has required a proponent of a co-located generation facility to pay the entire cost of the system upgrades required to connect it,¹³⁴ and legislators and regulators in several jurisdictions are considering making data centres subject to minimum

¹³² FERC, *Order Instituting Proceeding Under Section 206 of the Federal Power Act and Consolidating with Other Proceedings*, Docket No EL25-49-000 (20 February 2025), online: <ferc.gov>.

¹³³ Melissa Farney, “AI, Data Centers, and the Next Big Correction: Will Growth Outpace Market Reality?” (28 February 2025), online: <datacenterfrontier.com>.

¹³⁴ FERC, Docket No. ER24-3049-001, Notational Order (February 10, 2025) 190 FERC ¶ 61,080, note 29.

monthly charges, financial security requirements, and/or long-term contracts with substantial exit fees in the event service is terminated or if expected load does not materialize.¹³⁵

2. *Uneconomic Bypass*

Increased cost to customers can also arise where data centres (or other customers) that normally supply their own electricity needs with BTF generation also rely on the system for backup. For instance, if the costs of the system investment required to serve the data centre are recovered through a charge that is based on the data centre's actual demand on the system, a data centre's decision to self-supply can result in those costs being shifted to other system customers. This is termed "uneconomic bypass" of the transmission system.¹³⁶ It has been recognized in many jurisdictions including Alberta.¹³⁷

Uneconomic bypass is an important consideration in transmission rate design. It can be mitigated in various ways, such as by allocating a greater share of system costs to the connecting customer (e.g., by requiring a financial contribution in aid of construction);¹³⁸ by recovering any remaining system costs through a charge based on connection capacity (as opposed to actual demand); or by disincentivizing BTF altogether. Another approach, recently passed into law in Utah, attempts to avoid the cost of bypass (and other cost impacts to system customers) by allowing data centres or other large loads to negotiate supply contracts with utilities outside of the standard regulated framework, effectively requiring them to pay their own costs of service and establishing a "firewall" between them and other utility customers.¹³⁹

¹³⁵ See discussion below.

¹³⁶ The AUC has defined uneconomic bypass as "a situation where a customer's bypass decision (i.e., supplying its needs through other means) shifts the recovery of fixed system costs, in whole or in part, to other customers due to tariff design": AUC, Distribution System Inquiry: Final Report, Proceeding 24116, February 19, 2021, at para 3.4, online: <media.auc.ab.ca>.

¹³⁷ In AUC Decision 26911-D01-2022 (November 10, 2022) at para 93, the AUC noted that customers that normally supply their own electricity needs but rely on the system for backup "face lower supply risk and avoid costs that would otherwise be incurred to manage their supply risk as a result of the availability of the bulk transmission system but do not contribute significantly to recovering its costs".

¹³⁸ In Alberta, section 4 of the AESO tariff requires load customers connecting to the transmission system to pay the costs of their connection that exceed a calculated amount of "system-related" costs. Section 7 of the AESO tariff requires connecting generation customers to pay a contribution, calculated based on the maximum capability of the connecting generating facility and the location of the facility (pursuant to the Transmission Regulation, Alta Reg 86/2007, s 29).

¹³⁹ *Electric Utility Amendments*, Utah State Legislature, SB 132, 2025 Reg Sess (2025) online: <le.utah.gov>.

However, Utah’s approach appears to be unique, with most other jurisdictions treating data centres as typical system customers. Nor is there a current trend to disincentivize BTF generation: many governments, including Alberta’s, have been keen to encourage BTF generation for data centres as a means of reducing data centres’ impacts on system power levels, power prices, and reliability.¹⁴⁰ In most cases, therefore, the task of mitigating increased costs to customers from uneconomic bypass is likely to fall to system operators and utility regulators as a matter of rate design. Several rate proposals advanced to date in the United States include provisions designed to mitigate the risk of uneconomic bypass, such as enhanced customer contribution requirements and minimum monthly charges based on contract capacity. Alberta recently passed legislation requiring the AESO to implement tariff provisions ensuring that a “just and reasonable share of the costs of the transmission system” is recovered from customers that self-supply,¹⁴¹ but those provisions have yet to be designed and are unlikely to be put forward for approval until the AESO’s next rate design application in 2027.

3. *Reliability of the Transmission System*

Ironically, data centres’ need for reliable power supply is contributing to transmission reliability concerns. Their underlying need for reliable energy supply can increase pressure on the grid in several ways.

The demand accompanying data centres has the potential to increase the risk of blackouts in regions with high data centre concentration. An example of this occurred in 2024 in the American region nicknamed “Data Centre Alley”, when a transmission line fault triggered 1,500 MW of data centre load to be automatically disconnected from the grid and deferred to backup generation to protect the data centre’s operating systems.¹⁴² While the transmission system was able to recover quickly in this case, the North American Electric Reliability Corporation (“NERC”), the entity that monitors and assesses the reliability

¹⁴⁰ BTF may also be an attractive option for data centre proponents themselves for a number of reasons, as discussed above.

¹⁴¹ *EU Act* s 122(2)(b). The AUC may also impose conditions on industrial system designations requiring their owners to be responsible for paying a just and reasonable share of the costs associated with the interconnected electric system: *EU Act* s 117(2).

¹⁴² This aspect of data centres is referred to as “voltage-sensitivity”.

of the bulk power system in North America, warned that abrupt disconnections such as this, and uncoordinated reconnections, posed significant reliability risks if not managed adequately, especially as more large load customers are integrated into the network.¹⁴³

Part of NERC's incident review recognized that data centre reliance on uninterrupted power supply (UPS) systems¹⁴⁴ to protect from fluctuations in voltages, and the differences in UPS designs, make data centre behavior on the grid unpredictable in the event of system faults.¹⁴⁵

Reliability was also a central consideration in FERC's November 2024 decision to reject PJM Interconnection LLC's proposed terms of interconnection that would have facilitated expanded power sales to a co-located Amazon data centre from the Susquehanna nuclear power plant in Pennsylvania. In his concurring reasons, then-Commissioner Mark Christie (who is now the Chair of FERC) pointed to concerns raised by PJM's market monitor that the project would effectively remove a significant amount of baseload generation from the PJM markets, and that the reliability and rate impacts of this had not been considered by PJM.¹⁴⁶ FERC further considered the impacts of co-location on grid reliability in its technical conference on data centres and the matter looms large in the FERC Co-Location Proceeding.

In parallel with the FERC Co-Location Proceedings, FERC has initiated a technical conference to address resource adequacy risks germane to Regional Transmission Operator and Independent System Operator regions under its jurisdiction. The agenda for the conference specifically mentions data centres, further highlighting FERC's concerns with reliability amidst rising demand and evolving energy supply.¹⁴⁷

¹⁴³ NERC, *Incident Review: Considering Simultaneous Voltage-Sensitive Load Reductions* (8 January 2025) at 4, online: <nerc.com>.

¹⁴⁴ UPS systems secure uptime of large data centres and provide facility wide protection for sensitive electronics. See VERTIV "Data Center and Facility UPS" online, <vertiv.com>.

¹⁴⁵ NERC, *supra* note 144.

¹⁴⁶ Mark Christie, "Commissioner Christie's Concurrence in PJM's Susquehanna Co-Location Proposal, ER24-2172" (1 November 2024), online: <ferc.gov/news>.

¹⁴⁷ FERC, "FERC Issues Notice & Agenda for the Commissioner-led Technical Conference Regarding the Challenge of Resource Adequacy" (3 April 2025) Docket No. AD25-7-000: <[ferc.gov.com](https://www.ferc.gov)> - technical conference is scheduled to take place in June 2025.

Similarly, in Alberta, the AESO has recognized that data centres are driving rapid load growth without adding corresponding generation capacity – or are not doing so quickly enough – raising concerns about grid reliability.¹⁴⁸ This exacerbates existing reliability concerns arising from other factors, including an increasing proportion of intermittent supply and extreme weather events putting strain on the province’s electricity system.

C. Legislative and Regulatory Responses to Date

1. Data Centre-Specific Energy Legislation

Some jurisdictions are changing laws to protect customers from bearing disproportionate costs of data centre-driven infrastructure investment. Utah recently passed a law¹⁴⁹ allowing large energy users (>100 MW) to contract directly with generators outside of the standard regulated framework, with the objective of allowing large loads to be served without affecting demands and rates for existing utility customers. Other jurisdictions, including California,¹⁵⁰ Oregon,¹⁵¹ and Virginia,¹⁵² are considering legislation that would insulate utility ratepayers from the costs of serving data centre customers by various means, including by requiring state utility regulators to establish data centre-specific rate classes or by mandating long-term supply contracts for data centres. A proposed bill in Texas would require the state utility commission to implement minimum rates for data centres and other BTF-served customers based on the customer’s peak demand, effectively requiring them to pay the costs of their grid connections whether or not they use those connections.¹⁵³

Some legislative responses also address reliability. The proposed Texas bill would allow the state to effectively cut off power to data centres when the grid is facing an emergency, indirectly compelling data

¹⁴⁸ AESO, *supra* note 79, this does not include data centres located off-grid and supplying their own generation, as they do not follow AESO’s Connection Process.

¹⁴⁹ *Electric Utility Amendments*, Utah State Legislature, SB 132, 2025 Reg Sess (2025) online: <le.utah.gov>.

¹⁵⁰ Steve Padilla, “SB 57: Data centers: special tariff or program” (2025) online: <calmatters.digitaldemocracy.org>.

¹⁵¹ The Oregonian, “House Bill 3546” (2025), online <gov.oregonlive.com>.

¹⁵² Legislative Information, “SB1243: Electric utilities; electric distribution infrastructure serving data centres” (27 January 2025), online: <lis.virginia.gov>.

¹⁵³ Texas Senate, Bill 6 (2025-2026), online: <legiscan.com>.

centre proponents to invest in back up power supply.¹⁵⁴ Similarly, Utah’s legislation requires large customer contracts for intermittent resources to include arrangements for backup power supply – though not the 100% backup supply that the bill initially contemplated. Utah’s approach represents a step away from resource neutrality (state legislators rejected a competing bill that would not have constrained the sources of generation),¹⁵⁵ and reflects similar considerations regarding the role of renewable energy in serving new data centre loads that are informing market reform initiatives in other jurisdictions, including Alberta, where the Restructured Energy Market (**REM**) initiative is driven, in part, by perceived reliability concerns surrounding the increased share of generation provided by intermittent resources.

Conversely, several jurisdictions are contemplating objectives and incentives for data centres to monitor and invest in efficient and environmentally conscious power supply by setting data centre-specific efficiency standards or emissions targets. A framework for monitoring and regulating data centre energy use and efficiency has been established in the United States through the Energy Act of 2020, which requires the development of a metric for data centre energy efficiency and a data centre energy practitioner program.¹⁵⁶ At the state level, California is considering legislation that would require the developers of AI models to publicly report the energy used to train the model, require data centres to report their energy usage to the California Energy Commission (**CEC**), and authorize the CEC to implement efficiency requirements on data centres in the state.¹⁵⁷ Other proposed California legislation offers tax cuts to data centres that draw a certain proportion of their energy from zero-emission and BTF sources.¹⁵⁸ A proposed bill in New Jersey would require new AI data centres in the state to source their electricity from nuclear or new renewable sources to avoid a net decrease in such energy to the grid, if other states in the region impose similar requirements.¹⁵⁹ For its part, the European Union (**EU**) is moving to track key sustainability

¹⁵⁴ *Ibid.*

¹⁵⁵ Utah State Legislature, S.B. 227 Electricity Supply Amendments, (2025), online: <le.utah.gov>.

¹⁵⁶ U.S. Senate Committee on Energy and Natural Resources, “Energy Act of 2020”, online: <energy.senate.gov>.

¹⁵⁷ California Assembly, Bill AB 222: Data centers: energy usage reporting and efficiency standards: electricity rates (2025), online: <leginfo.legislature.ca.gov>.

¹⁵⁸ California Legislature, Senate Bill No. 58 (8 January 2025), online: <legiscan.com>.

¹⁵⁹ State of New Jersey Senate Environment and Energy Committee, Statement to Senate, Bill S4143 (17 March 2025), online: <njleg.state.nj.us>.

measures of data centres and mandate best practices and technologies to optimize energy consumption,¹⁶⁰ in what some commentators see as an important first step towards regulating their energy use and supply.¹⁶¹ These efforts build on the EU’s common framework of measures to promote energy efficiency,¹⁶² and existing measures to reduce the environmental impact of IT infrastructure by establishing eco-design requirements for servers and data storage systems.¹⁶³

2. *Regulators’ Responses to Data Centre-Related Issues*

Utilities and transmission operators in several jurisdictions have also proposed data centre-specific rate classes, tariff provisions, or connection requirements. Most of these proposals aim to manage risks to existing customers by insulating them from reliability and cost impacts of data centre-related projects.

The ongoing FERC Co-Location Proceeding was prefigured by a number of proposals seeking to accommodate various forms of co-location within FERC-jurisdictional transmission grids and rates. In addition to the Susquehanna proposal discussed above, these included a proposal by Wyoming’s Basin Electric Power Cooperative to introduce three new rate schedules for crypto mining operations and other related schedules. FERC rejected the proposed rate schedules on the basis that Basin had not demonstrated that the proposed rates met the requirements of the Federal Power Act, including that they be “just and reasonable” and “not unduly discriminatory or preferential”.¹⁶⁴ However, FERC was sympathetic to Basin’s concerns regarding its ability to serve expected load growth and clarified that its rejection of its proposal was without prejudice.¹⁶⁵ In another docket, a group of utilities within the Exelon family proposed a suite of tariff revisions designed to address uneconomic bypass arising from co-located load, among other

¹⁶⁰ European Commission, “Commission adopts EU-wide scheme for rating sustainability of data centres” (15 March 2024), online: <energy.ec.europa.eu>.

¹⁶¹ Grant Gross, “EU moves toward regulating data center energy and water use” (15 May 2024), online: <cio.com>.

¹⁶² European Parliament *Directive 2012/27/EU* (25 October 2012), online: <eur-lex.europa.eu>.

¹⁶³ European Parliament, *Regulation (EU) 2019/424* (15 March 2019), online: <eur-lex.europa.eu>.

¹⁶⁴ FERC, Docket Nos. ER24-1610-000 and ER24-1610-001, Order Rejecting Proposed Rate Schedules (August 20, 2024), 188 FERC ¶ 61,132.

¹⁶⁵ *Ibid.* at para. 1.

matters. FERC rejected the proposal on technical grounds but ruled that generic issues regarding co-location would be considered in what would become its Co-Location Proceeding.¹⁶⁶

In Ohio, the Public Utilities Commission of Ohio (**PUCO**) is considering a proposed new “data centre tariff” for large data centres in the service territory of transmission utility AEP Ohio. The proposal, advanced by AEP Ohio, includes 12-year contract commitments, a requirement that data centres pay for at least 85% of their peak demand, exit fees equivalent to three years of minimum charges, restrictions on load ramping, and collateral requirements equal to 50% of projected costs for lower-credit customers. AEP Ohio justified these terms as necessary to prevent stranded costs, ensure cost recovery for grid expansions, and protect other ratepayers from subsidizing high-energy users. AEP Ohio’s proposal was supported by a broad coalition of interested parties, including ratepayer representatives,¹⁶⁷ but was opposed by another coalition, including generators and data centre proponents, who brought forward a competing proposal of their own.¹⁶⁸ PUCO staff filed a brief strongly supporting AEP Ohio’s proposal, and framed the fundamental issue as whether data centres or other customers should bear the risk of large-scale transmission investments necessary to support data centre growth.¹⁶⁹

In Indiana, transmission utility Indiana Michigan Power and certain stakeholders including ratepayer representatives and data centre proponents (including Amazon Data Services, Microsoft and Google) reached an agreement outlining the terms for connecting new large loads (including but not limited to data centres) to the grid. The Indiana Utilities Regulatory Commission (**IURC**) approved the filed agreement with minor modifications.¹⁷⁰ It includes a 12-year minimum contract term following a ramp-up period of no more than 5 years; a minimum charge of 80% of monthly billing demand intended to provide the utility

¹⁶⁶ FERC, “E-8-ER24-2888-00” (20 February 2025), online: <ferc.gov>.

¹⁶⁷ PUCO Case No. 24-508-EL-ATA, Joint Stipulation and Recommendation (23 October 2024), online: <dis.puc.state.oh.us>.

¹⁶⁸ PUCO Case No. 24-508-EL-ATA, Joint Stipulation and Recommendation (10 October 2024), online: <dis.puc.state.oh.us>.

¹⁶⁹ PUCO, Case No. 24-508-EL-ATA: Initial Brief Submitted on Behalf of the Staff of the Public Utilities Commission of Ohio, (28 February 2025), online: <dis.puc.state.oh.us>.

¹⁷⁰ Indiana Utility Regulatory Commission, “Order of the Commission” (19 February 2025), online: <secure.in.gov>.

with a stable and predictable revenue stream to support required capital investments; collateral requirements; and exit fees set based on contract amounts and triggered by capacity reductions or early termination of service. The IURC determined that its order would be beneficial for existing customers, provide certainty for utility providers, and increase risk for data centre developers.

No data centre-specific rates, rate classes or tariff provisions have been proposed in Alberta to date. However, on April 30, 2025, the AESO released connection process requirements specific to data centres, including proposed technical and operational information – such as load composition, backup generation and operational behavior – that project proponents would be expected to provide as their projects advance through the connection process.¹⁷¹ These requirements are not yet mandatory but serve as an initial framework that the AESO expects to refine over time.¹⁷² Various aspects of Alberta’s REM and transmission policy development processes are also likely to affect the way data centres participate in the Alberta electricity markets and, correspondingly, investor perceptions of those markets and the province generally as a destination for investment. The potential impacts on data centres of Alberta’s REM and transmission policy is a complex topic that is beyond the scope of this paper. However, we highlight two points of potential interest to data centre proponents and investors. First, the details of any locational cost signals (including whether the contemplated Transmission Reinforcement Payment will be refundable) will be important as they will determine, among other things, the effectiveness of those signals as a guide to generation project siting and the degree of reliance on longer-term cost recovery mechanisms, potentially impacting the attractiveness of BTF or co-located generation for a given project. Second, the AESO’s proposal to require day-ahead demand commitments to have the ability to ramp up and down could benefit data centre proponents that are capable of ramping down their demand, but if projected load of this nature

¹⁷¹AESO, “Data Centre Technical and Operating Characteristics” (30 April 2025), online: <aeso.ca> ; and AESO, *supra* note 79.

¹⁷² *Ibid.*

does not materialize then participation from flexible loads may fall short. (At the time of writing, the AESO had indicated it was abandoning the proposed day-ahead commitment market.¹⁷³)

Data centre-specific rates, rate classes, or tariff provisions do not always go unchallenged, however. They are frequently objected to on the basis that they contravene legal requirements that public utilities serve all customers in a non-discriminatory manner. In its Susquehanna decision, for instance, FERC voiced concerns over whether PJM had the intention of offering the terms found in the ISA to all “similarly situated interconnection customers”.¹⁷⁴ Power producers opposed to the Exelon utilities’ proposal claimed that the proposal was discriminatory because it would require them to become transmission service customers whether they take service or not.¹⁷⁵ Similar concerns have been raised about the AEP Ohio proposal under the no-discrimination provisions in Ohio legislation.¹⁷⁶

The availability and strength of these discrimination arguments depends on the proposed rate and tariff provisions and the applicable legislation. Most jurisdictions have legislation prohibiting “undue” discrimination in tariffs and rate design. This is the requirement under the United States’ Federal Power Act (which governs FERC’s jurisdiction)¹⁷⁷ and in Alberta, under the *Electric Utilities Act* which requires that tariffs be “not unduly preferential, arbitrarily or unjustly discriminatory”.¹⁷⁸ Discrimination cases thus typically turn on whether the facts disclose a reasonable basis for treating a given customer or class of customers differently.¹⁷⁹ Discrimination arguments may be harder to raise in response to proposals that are

¹⁷³ AESO, “Stakeholder Updates” (4 April 2025), online: <aesoengage.aeso.ca>; Bill 52 has passed 3rd reading in the legislative assembly - with no amendments removing reference to “day-head market” - though the AESO has indicated it will not move ahead with the “day-ahead commitment market” - so, it’s unclear how this will be reflected in the legislation.

¹⁷⁴ FERC, Docket Nos. ER24-2172-000 and ER24-2172-001, Order rejecting amendments to interconnection service agreement (November 1, 2024) 189 FERC ¶ 61,078 at para 87.

¹⁷⁵ FERC, Docket Nos., ER24-2888-000, ER24-2889-000, ER24-2890-000, ER24-2891-000, ER24-2893-000 and ER24-2894-000, Protest of Constellation Energy Generation, LLC (2 October 2024) at 1-2, online: <ferc.gov>.

¹⁷⁶ See commentary in Yoon Kim, “Guest Blog: Connecting Data Centers to the Grid: An Innovative and Controversial Proposal from AEP Ohio” (September 12, 2024), Columbia Law School, Climate Law, online: <blogs.law.columbia.edu>.

¹⁷⁷ See *Federal Power Act*, 16 U.S.C. § 824e(a).

¹⁷⁸ *Electric Utilities Act*, S.A. 2003, c. E-5.1, s 121(2)(b).

¹⁷⁹ In Alberta, the AUC considers that undue discrimination can arise (1) “when a utility fails to treat all its users equally where no reasonable distinction can be found between those favoured and those not favoured”, or (2) “when

less specific in their application, such as proposals that apply to large load customers generally, rather than data centre customers specifically. The burden of demonstrating a proposed tariff’s compliance with the legislation often rests with the proponent, as FERC noted in rejecting Basin Electric’s proposed rate schedules.¹⁸⁰

Proponents of data centre-specific rates and tariff provisions have defended different treatment for data centres based on the scale of their potential loads, expectations of future growth, economic impact, and their sheer novelty. However, few decided cases have considered discrimination in the context of data centres specifically. In Indiana, the IURC approved a rate framework that applied to large load customers generally, implicitly finding that it did not contravene that state’s statutory prohibition on discriminatory tariffs. In another recent decision the British Columbia Court of Appeal upheld the reasonableness of the B.C. Government’s conclusion that cryptocurrency mining operations constituted a class of projects with (in the Court’s words) “distinctive electrical consumption characteristics that had both cost-of-service and economic impacts” that justified the different treatment complained of (in that case, a crypto-specific moratorium).¹⁸¹

The high degree of interconnectedness of the North American transmission system can also give rise to discrimination concerns to the extent a patchwork of policies and tariffs emerges within a single regulatory jurisdiction. For instance, AEP Ohio’s proposal could save Ohio customers money but would do little to protect other PJM customers. It has been argued that this constitutes a form of undue discrimination, which is prohibited by legislation at both the FERC and Ohio state levels. This concern emphasizes the need for coordination and cooperation between utilities and jurisdictions to ensure that customers are fairly treated.

a utility treats all its users equally where differences between users would justify different treatment”: AUC Decision 2013-295, K. David Campbell, Appeal on EWSI Water Rates for 2012-2017 (August 9, 2013) at para. 36.

¹⁸⁰ FERC, Docket Nos. ER24-1610-000 and ER24-1610-001, Order Rejecting Proposed Rate Schedules (August 20, 2024), 188 FERC ¶ 61,132 at paras. 94-97.

¹⁸¹ *Conifex Timber Inc. v British Columbia (Lieutenant Governor in Council)*, 2025 BCCA 62 at paras 87-105 [Conifex].

Discrimination is a live issue in the FERC Co-Location Proceeding and may receive some treatment there in the context of the proposals advanced.

3. *Moratoriums on Data Centre Connections*

As opposed to data centre targeted legislation or rate and tariff provisions, in some jurisdictions, the recent surge of data centre connection applications has been met with absolute moratoriums on certain types of projects. In Canada, the provinces of BC, Quebec and Manitoba have each imposed moratoriums on the connection of cryptocurrency mining facilities to provincial power grids.¹⁸² In the U.S., AEP Ohio's data centre rate proposal was accompanied by a moratorium on new data centre connection applications, and similar measures have been called for in Indiana¹⁸³ and before FERC.¹⁸⁴ Moratoriums are commonly presented as temporary measures to pause development while industry and regulators develop measures to address emerging issues. While they can buy time, however, such moratoriums can come at the cost of investor confidence and risk dampening enthusiasm for investment in the jurisdiction.¹⁸⁵ Depending on the applicable laws, a moratorium can also be subject to legal challenge. BC's crypto-mining moratorium, for example, was unsuccessfully challenged in the courts, including on the basis of discrimination,¹⁸⁶ and AEP Ohio's moratorium has been challenged before the state utilities regulator as a contravention of the utility's statutory duty to serve its customers.¹⁸⁷

¹⁸² Cryptocurrency Power Regulation, B.C. Reg. 163/2024; A Directive to Manitoba Hydro Electric Board Respecting Electric Service to Cryptocurrency Operations, effective April 10, 2024; Québec Régie de l'Énergie, Decision D-2023-002, Décision relative à la demande d'ordonnance de sauvegarde (10 January 2023).

¹⁸³ Citizens Action Coalition, "CAC Calls for Data Center Moratorium" (15 October 2024) online: <citact.org>.

¹⁸⁴ Ethan Howland, "AEP, others press for FERC guidance on 'gargantuan' issue of data center colocation" (4 November 2024), online: <utilitydive.com>, citing comments from Maryland state Sen. Katie Fry Hester (D).

¹⁸⁵ This was alleged to have been among the effects of Alberta's recent seven-month moratorium on renewable power plant applications (as argued by the Pembina Institute: see e.g. Will Noel et al., "Creating (Un)certainly for Renewable Projects") (August 2024), online: <pembina.org>; although the responsible Minister denied this quoted in Bob Weber, "Alberta renewable energy pause left legacy of cancelled development: study" (2 August 2024), CBC News, online: <cbc.ca>.

¹⁸⁶ *Conifex*, *supra* note 181 at paras 87-105.

¹⁸⁷ See commentary in Yoon Kim, "Guest Blog: Connecting Data Centers to the Grid: An Innovative and Controversial Proposal from AEP Ohio" (12 September 2024), Columbia Law School, Climate Law, online: <blogs.law.columbia.edu>.

It is notable that various jurisdictions have addressed data centre expansion with a wide – and sometimes inconsistent – array of regulatory and legislative measures, ranging from incentives and data centre-specific rate classes, tariff provisions, or connection requirements, to outright moratoriums. It seems clear that regulators and legislators are struggling to respond to the rapid, and perhaps existential, opportunities and risks associated with data centre electricity demands.

IV. COMMERCIAL AND PROJECT ISSUES SPECIFIC TO DATA CENTRES

Moving from electricity-supply considerations from the perspective of utilities, regulators and generators to the perspective of the consuming data centre, we note a number of innovative commercial solutions that are developing in response to the distinctive features of data centre power procurement. While in many respects similar to other large load requirements, data centres also have unique power load shape, ramping, reliability, pricing and performance issues that require specialized commercial treatment. The following offers a consideration of some of the unique commercial issues related to data centre power procurement arrangements.

A. Electricity Price

Procuring reliable and cost effective electricity is crucial to meeting the growing electricity demand from data centres.¹⁸⁸ In addition to procuring the grid electricity mix, data centres are frequently acquiring electricity through PPAs. PPAs between private generators and consumers of electricity are only available in some jurisdictions,¹⁸⁹ notably the deregulated Alberta market which allows generators to enter contracts directly with private off-takers. The use of PPAs to provide price and supply certainty to an industrial user is common in other sectors, but may involve subtle nuances for data centre load. The regulatory context

¹⁸⁸ IEA, “Energy and AI”, *supra* note 4 at 75

¹⁸⁹ Manitoba and Saskatchewan prohibit the retail supply of power from any persons other than Manitoba Hydro or SaskPower. See *Manitoba Hydro Act*, RSM 1987, c H190, s 15.2; *The Power Corporation Act*, RSS 1978, c P-19, s 38; Simon Baines et al, “#HowtoPPA: An Examination Of The Regulatory and Commercial Challenges And Opportunities arising In The Context Of Private Power Purchase Agreements For Renewable Energy” (2019) 57:2 at 396; Ontario has recently introduced regulatory amendments allowing certain market participants to enter PPAs with renewable generators expected to come into force May 2025, *Ontario Regulation 429/04 Amendments Related to the Treatment of Corporate Power Purchase Agreements*.

and key terms of PPAs have been explored in depth by others,¹⁹⁰ so this section will focus on certain features of PPAs and VPPAs that may be of specific interest to data centres.

Electricity price predictability is a fundamental goal of data centre power procurement arrangements. Variations on pricing formulas may include having the energy price fixed for duration of the contract; having the price fixed but with set escalations based on usage, inflation or milestone dates; having the energy price fixed but with settlements between different parties depending on wholesale prices; and having the price indexed to energy markets with various discounts and/or floors and ceilings. Each of these can be customized so that the revenue cost risks are allocated between the generator and user in a manner which is consistent with the data centre risk profile.

Pricing can also be impacted by load factor. Load factor is the average power use compared to peak power usage during the same period, measured as a percentage. The load factor for a crypto mining facility that is dependent on the value of the currency may be lower due to the sharp changes in monthly usage, whereas a large load data centre, such as one involved in training LLMs for gen AI, may have a higher load factor of 90 to 100% since its demand is generally constant. In other words, the load factor may be dependent on the type of customer and use. The commercial arrangement, therefore, may include a load factor charge to penalize those customers that do not maintain a certain load factor, to secure greater certainty of revenue for the power supplier. The parties may also have to consider the effects of efficiencies over time, including technological efficiencies (computing and chip efficiency); data centre architecture (server placement), and cooling technologies, which may have the effect of reducing load requirements over time.

In addition to a charge based on energy usage, large commercial and industrial loads may also include a demand charge component, which is used to cover the load's associated fixed costs. The demand charge is used to cover fixed costs associated with the customer's load and is based on the peak demand during the billing period. To reduce the risks from serving customers with large swings in demand, a demand charge

¹⁹⁰ Baines et al, *supra* note 189 at 389.

is calculated using a demand ratchet which establishes the level of demand charge based on the actual peak demand for the billing period, or a percentage of the highest peak recorded (e.g., 80%) during the previous specified months (e.g., 11 months), whichever is greater. For example, if the facility experiences a peak demand of 1,000 kW for one hour, the customer is billed for a minimum of 800 kW during the next 11 months, even if the actual demand is much lower. This is designed to require the customer to pay for the assurance of having the high capacity when needed and to provide for the recovery of fixed charges for peak demand. It also encourages the customer to maintain a level of demand that is consistent since the customer would have to pay for demand not used if it does not do so. This commercial formula provides an incentive for consistent demand, and may mitigate the risk that a data centre customer can shift usage to other jurisdictions or to different times resulting in demand fluctuations.

B. Emissions Reduction Goals

Data centres account for one percent of global carbon emissions (equal to 330 million tons of carbon dioxide equivalent). By one estimate, the cloud has a greater carbon footprint than the airline industry.¹⁹¹ As noted above,¹⁹² data centre users often look to PPAs as a way to offset the carbon emissions and meet corporate or regulatory objectives restricting carbon emissions.

While typical renewable PPAs enable new clean generation capacity, they are not compatible with full data centre decarbonization because of the timing mismatch between generation and consumption, also known as temporality. In other words, while a typical PPA seeks to match *annual* electricity consumption with renewable energy consumption, it does not account for *hourly* variations on energy demand and supply. Variable renewables cannot generally match hourly demand throughout the year—for example where solar alone is procured to meet annual demand, on an hourly basis the solar output is only able to meet approximately 35-45% of data centre demand due to solar’s output profile,¹⁹³ and where on-shore wind

¹⁹¹ Steven Gonzalez Monserrate, “The Staggering Ecological Impacts of Computation and the Cloud” *The MIT Press* (14 February 2022), online: <thereader.mitpress.mit.edu>.

¹⁹² *Ibid.*

¹⁹³ IEA, “Energy and AI”, *supra* note 4 at 82.

alone is procured to meet annual demand, on an hourly basis the wind output is only able to meet approximately 65% of the data centre demand.¹⁹⁴ In order to further reduce their carbon footprint and achieve their sustainability objectives, some large data centre proponents have committed to powering their operations with 24/7 renewable energy through modified PPAs that employ hourly load matching, termed 24/7 carbon free energy (CFE) matching.¹⁹⁵ The 24/7 PPA is designed to ensure that every hour of electricity consumption is matched with renewable energy generation through real time tracking and verification of energy production and consumption.¹⁹⁶ This requires a portfolio of renewable energy and storage projects, and access to dispatchable sources of low-emissions electricity such as hydro, nuclear, and geothermal.¹⁹⁷ Hybrid portfolios of wind, solar, and storage can often cover 80% of hourly matching at a price competitive with industry retail price, although exceeding that percentage involves a premium price.¹⁹⁸ Interestingly, technologies such as blockchain and real time data analytics could themselves be crucial for tracking green electrons by origin and timing.

In effect, 24/7 PPAs refine the traditional PPA and REC models, which simply offset a data centre's annual consumption with green-energy credits. 24/7 CFE matching involves an energy buyer procuring green energy to match its facility's load in every hour.

One weakness in 24/7 CFE matching, however, is that it does not resolve the issue of intermittency inherent to renewable energy sources, which can result in mismatches between generation and data centre consumption. This means that data centres employing 24/7 CFE matching may still need to rely on alternative, reliable power sources in order to maintain seamless operations. Moreover, current energy

¹⁹⁴ *Ibid* at 84.

¹⁹⁵ Google, for example, has committed to transition to 24/7 matching by 2030; see Google, "Innovating sustainable ideas. Growing renewable solutions" (2025), online: <datacenters.google/operating-sustainably>.

¹⁹⁶ Mark Dyson, Sakhi Shah, & Chaz Teplin, *Clean Power by the Hour: Assessing the Costs and Emissions Impacts of Hourly Carbon-Free Energy Procurement Strategies* (New York: RMI, 2021) online: <rmi.org>.

¹⁹⁷ IEA, "Energy and AI", *supra* note 4 at 75.

¹⁹⁸ *Ibid* at 85.

infrastructure lacks the sophistication to support concurrent tracking and procurement processes necessary for 24/7 CFE matching at scale.¹⁹⁹

In addition to commercial solutions to achieve emissions reductions goals, such as PPAs and 24/7 CFE matching, data centre users may also try to better match generation and consumption by managing data centre operations. By shifting workload amongst various data centres by time (enabling data centres to shift flexible tasks to different times of the day), and by migrating certain moveable parts of their own workload between different facilities, data centre operators may try to achieve the greenest operations.^{200,201} Users may also encourage their own customers to make decisions on where to host workloads to ensure workload and consumption are better matched to renewable generation profiles.²⁰² In effect, the data centre and its users, unlike a typical utility load, cooperatively manage their operations to better match consumption with intermittent renewable energy supply. While potentially beneficial to data centres and the environment, however, this operational shifting can make load forecasting and grid operations significantly more difficult by causing facilities' actual load profiles to differ from the profiles used to model the system. This can shift additional burden to the system operator, and from a commercial perspective can incentivize the electricity provider to seek contractual minimum load requirements or price assurances in order to mitigate revenue uncertainty and risk.

¹⁹⁹ Nate Hausman & Lori Bird, "The State of 24/7 Carbon-free Energy: Recent Progress and What to Watch" (5 May 2023) online: (blog) <wri.org>.

²⁰⁰ Dan Swinhoe, "Everything Data Centre Operators Need to Know About Power Purchase Agreements (PPAs)—A PPA Primer for Data Centre Companies" *DCD Magazine* (April 2023), at 48 online: <issuu.com>. Tasks such as media processing which encodes, analyzes and processes millions of multimedia files like videos and photos. Not all tasks are moveable as workloads covered by data sovereignty laws or cloud customer tasks will still be based out of their original data centre.

²⁰¹ Ross Koningstein, "We now do more computing where there's cleaner energy" (18 May 2021), online: <blog.google/outreach-initiatives/sustainability/carbon-aware-computing-location/>.

²⁰² Swinhoe, *supra* note 201. Google has a Carbon Free Energy Percentage tool which shows the average mix of renewable energy to its data centres (which shows how often a region was supplied with carbon free energy on an hourly basis, on average) so that customers can make choices about where data and applications are hosted — (i.e. to pick lower carbon regions for new applications or batch jobs). Microsoft also publishes the energy mix data of its Azure cloud regions.

C. Multi Tenant Data Centres.

In multi-tenant data centre models, the data centre operator hosts a data centre where servers, networking hardware and data traffic are shared by a variety of tenants. These structures give rise to additional commercial considerations for a PPA relative to single-enterprise data centres or hyperscalers²⁰³ where the end-users of the energy are also the owners and operators, since, in a multi-tenant model, the load and duration required by each tenant may not align with the duration or load that the host is trying to acquire on their behalf. This creates a potential mismatch between the timing and volume of electricity procured under the master PPA and the actual usage by the tenants. Tenants may also have differing views on bearing the additional costs and risks of the PPA, or may have different tenancy terms which are inconsistent with longer term PPA duration. In addition, tenants may have differing energy usage over time depending on the proportion and type of AI usage and the status of the server processes (data storage, learning, inferences). As a result, multi-tenant PPAs may require greater flexibility to increase and decrease supply, or to extend or abridge the duration to better match tenant needs.

D. Ramping

During at least the first 6 months and perhaps up to three years a data centre building coming online, its usage is usually sporadic, ramping up for a while as the server cabinets and other IT equipment come online. To address this, data centres may arrange a “standard contract” with a generator until the load is more stable, and then procure a standard, long term PPA once stable. Generating parties may also set out load ramp periods that establish monthly peak load requirements as the data centre comes online and that stipulate that the overall requested load of the data centre will commence services within a set period of time.²⁰⁴ These provisions of the contract would also require that billing demand not be lower than a minimum percentage of the data centre’s load ramp contract capacity to ensure the fixed costs of serving the load are covered even if the customer has not reached the threshold level of demand. In addition to the

²⁰³ Examples of hyperscalers include major cloud providers such as Amazon Web Services, Google Cloud, Microsoft Azure, and IBM Cloud.

²⁰⁴ This is the commercial equivalent to the regulatory solutions noted in Part IV above.

ramp up periods, there may also need to be “ramp down” periods. Ramp down requirements may arise if technological or process efficiencies reduce power load over time and also due to the nature of AI data centre phases (During the training phase, for instance, the AI program is digesting vast amounts of data to build the associations need for the model to work and thus has consistently high power requirements.²⁰⁵ In the utilization phase, by contrast, the completed model is responding to user enquiries and may have lower power requirements.²⁰⁶) Efficiencies may also come from more productive cooling systems. The load profile of any commercial arrangement, therefore, may have to take into account these ramp up and ramp down periods.

E. Daily Use Load Shape

Currently, AI data centres tend to be high load factor, mostly base load facilities with a relatively flat shape. This reflects the fact that AI is currently in continuous development and primarily dedicated to model training. However, there is a possibility that the daily load shape may change as the function and usage of AI evolves. For example, if AI evolves from mostly “training phase” to greater “usage phase” (responding to user enquiries), the daily peak would be more dependent on usage time. When AI is used as a business tool, for example, the AI usage would coincide with business hours whereas when AI is used as a personal tool the usage would coincide with morning and evening peaks like a residential load.²⁰⁷ There is substantial uncertainty around future load shape, but it is unlikely to be truly flat. This has significant ramifications for grid planners and system operators, and also for data centre proponents and their electricity suppliers, who must ensure their commercial power arrangements reflect the risks and consequences of these varying daily load shapes.²⁰⁸ Compounding this commercial issue, it is expected that there will be uneven distribution of data centres geographically, with clusters attracted to certain hubs due to population centers, low electricity

²⁰⁵ While energy consumption for training varies according to the model size and complexity and hardware configuration, it is estimated that GPT-4 was trained for 14 weeks, and assuming a load factor of 84% the training energy demand of that model was approximately 42.4 gigawatt hours.

²⁰⁶ Isabelle Riu et al, *Load Growth is Here to Stay, but are Data Centres?* (San Francisco: Energy and Environmental Analytics, July 2024) online: <ethree.com>.

²⁰⁷ *Ibid.*

²⁰⁸ This is the commercial equivalent of the regulatory forecasting difficulty discussed in Part IV above.

and land costs, internet connections, and local incentives.²⁰⁹ The evolution and fluctuations of load shape over a long term PPA will be a difficult risk to negotiate and properly allocate.

F. Change in Law

Project proponents and their lenders will be anxious to ensure that the cash flows of the data centre project are appropriately protected against changes in law. The concept of addressing the risk of a change in law in a PPA is a familiar concern that has been well canvassed by others, but that may be more acute in the data centre context. In the event of a change of law that results in a change to the economic or financial performance of a contract without preventing or prohibiting actual performance,²¹⁰ parties to a commercial power arrangement may agree in advance how the costs or benefits resulting from the change are to be allocated between them. In addition to the “ongoing development (and revisiting) of policies regarding electricity market structures and renewable energy policies by many governments and the ensuing legislative and regulatory change to implement such policies”,²¹¹ the policy and legislative changes applicable to data centres are (almost) as rapidly evolving as the underlying technology. The change of law clause, therefore, may not only be triggered by changes in the market structure or applicable legislation or regulation, it may also be triggered by the regulation of AI technology and AI usage itself.

As noted above, we have also seen differing government policy approaches to entice or discourage data centre development in various jurisdictions. For example, many jurisdictions and local governments have expressed policies and offered incentives to lure data centre operations to their jurisdictions, including active policies in Alberta²¹² and other provinces, and state sales and use tax exemptions in Maryland and North Carolina,²¹³ among many other incentives. However, since data centres are largely automated, do not require much maintenance and do not always trigger additional local investment, some governments,

²⁰⁹ Riu, *supra* note 206.

²¹⁰ Baines et al, *supra* note 189 at 389.

²¹¹ *Ibid* at 408.

²¹² Alberta, Ministry of Technology and Innovation, *Alberta's AI & Data Centre Strategy* (Edmonton: Government of Alberta, 2024), online: <open.alberta.ca>.

²¹³ Christopher Tozzi, “The State of Data Centre Tax Incentives and Legislation in 2023” (15 March 2023), online: <datacenterknowledge.com>.

including Virginia and Idaho, and countries such as Sweden and the Netherlands,²¹⁴ have since been reconsidering, limiting or even eliminating tax and other incentives for data centres. We may also see moratoriums on further data centre development or restrictions on certain usages. Depending on the scope of the change in law provision in the commercial arrangement, change of law remedies may be triggered by such shifts in government policies and incentives.

G. Term

Due to the uncertainty associated with the uptake, usage and longevity of data centre facilities, and the rapid depreciation, evolution and replacement of the technology, the parties to the PPA should define their rights and obligations (and associated costs) if the consumer needs to exit the data centre or extend the term of the contract. There should be adequate time for termination and/or extensions since developing and engaging with a data centre can be a long and complex process. The contract term may also be longer than the term related to pricing due to the difficulty of forecasting pricing over an extended period, however, the parties are then left to reconsider the pricing formula or arrangement at a later date in unknown market circumstances. There may be penalty payments, including acceleration payments, if the term of the PPA is ended early. This also gives rise to a corresponding need for financial assurances to support this obligation. To ensure funding for the electricity infrastructure investment, the data centre proponent may be asked to enter into a longer-term (e.g., 10 year) service contract and/or agree to an exit fee to pay to either leave the contract prior to the expiry date, or to reduce the contract capacity below an agreed threshold. Considering the significant costs of data centre development, including the associated power facilities and procurement investments, a form of acceleration payment may be a reasonable solution to the mismatch between rapidly developing and rapidly obsolete technology contrasted with long term and slow depreciating power facilities.

²¹⁴ NESCOE, *Data Centres and the Power System, A Primer* (Calgary: NESCOE, 5 June 2024), online: <nescoe.com>.

H. Take-Or-Pay and Minimum Take provisions

Parties can utilize these provisions to guard against volatility in the energy-intensive computing industry to require the data centre's users to pay for a certain amount of power regardless of how much it uses. The PPA may indicate if the minimum demand is based upon the location, service point, or customer to avoid a customer structuring its demand below the minimum demand threshold by, for example, having multiple meter points. It may be difficult, however, for parties to forecast a minimum power commitment considering that rapid innovation in software and hardware energy efficiency may be partially or entirely off-set by greater usage and higher complexity models.

I. Investment funding and Contributions to Construction:

Depending on whether the data centre will connect with existing infrastructure, or partially depend on BTF generation, there may be significant capital costs for the generating party. For instance, at the commencement of the project, the data centre proponent may be required to pay for or contribute to a feasibility study to determine the system upgrades that are required to accommodate the new load, including new electric infrastructure, line extension or service upgrade.²¹⁵ Assigning such costs to the customer for new or expanded electrical services is not unusual, but data centre proponents may be asked to provide deposits, contributions in aid of construction (CIAC), surety bonds or other financial support for substations and other infrastructure investments to defray the generating party's up front cost and to mitigate the risks of stranded assets. This provides for an allocation of up front costs to the project proponent. Such contributions may be more difficult to secure in multi tenant data centres than in hyperscale enterprise data centres.

²¹⁵ In Alberta, any transmission-level additions or upgrades required to serve new load are detailed in a Needs Identification Document (NID) prepared by the AESO and filed with the Alberta Utilities Commission. A project proponent may be required to fund – or contribute to – the AESO's engineering and cost-estimate studies that form the basis of the NID pertaining to transmission upgrades required for their particular project.

J. Force Majeure provisions

In a typical force majeure clause, a contracting party is relieved from complying with its contractual obligations (and liability for damages) for disruptions arising from specified events over which it has no control. It is common for the parties to negotiate the scope of the force majeure relief and the triggering events. Data centres and their operations may present unique triggering events, or specific consequences of invoking force majeure. Considering the need for reliable power, data centre proponents may consider whether an inability of the generating party to obtain or sustain government approvals should be a force majeure event; whether the force majeure relief should be adapted to different technologies considering that a gas fired power plant may have different disruption risks than a wind or solar generator; whether failure of the generator's suppliers, subcontractors or carriers should be sufficient to invoke force majeure relief; and whether an inability to secure materials or failure of equipment and machinery should be a force majeure event. The scope and triggering event of force majeure clause may also differ depending on whether the generator is the UPS or the redundant power supply, where reliability needs are even more acute. Considering the pressure to complete data centres on time, and the 24/7 demand of data centres the nature, scope and effect of force majeure events may impact the data centre user's need to invest in redundancy. Force majeure clauses should also not be so broad as to negate or compromise the reliability of the data centre itself.

K. Performance standards.

PPAs may be structured to include sanctions or require the power supplier to pay liquidated damages if it fails to deliver power when or as promised. This may include liquidated delay damages if the construction of the power project is not completed on schedule, or tariff abatements where the facility does not meet agreed performance standards during the operational phase. While these contractual features are not unique to data centres, data centre off-takers may be less satisfied with liquidated damages as remedy for failed or

delayed performance given the requirement for timely and 24/7 power supply, and instead seek redundancy or back up generation to ensure performance.²¹⁶

V. CONCLUSION

The discussion surrounding AI-driven data centre development is continuously evolving and much remains uncertain. Whether the projected surge in electricity demand driven by global uptake of AI-based technologies fully materializes, or is fundamentally reshaped by advances in technology, remains to be seen. In the face of this uncertainty, regulators have the tall task of allocating risk fairly among customers, developers, and utilities – balancing responsible infrastructure investment with ratepayer protection and encouraging innovation. Data centre proponents and investors in energy infrastructure must navigate changing seas. What is clear, however, is that differences in geography, infrastructure readiness, and regulatory landscapes across jurisdictions will be critical in determining where data centres are built and how they are powered. Local energy policies, permitting and connection processes, and access to reliable, low-emission power will all play a role in determining where data centre proponents decide to establish their operations, what those operations look like, and how they are structured from a commercial perspective. The increasing trend of large-scale BTF arrangements will also impact data centre investment trends. This is particularly so as major players pursue BTF arrangements at a scale that rivals incumbent utility generation capacity, raising novel queries about whether and how massive new generation and load will interact with existing grids. In Alberta – where a deregulated power market, diverse energy resources, and unique transmission cost allocation mechanisms coexist – these dynamics are particularly pronounced. Harmonizing the wide range of technical, economic, environmental (and inherently political) issues raised by large-scale data centre development will require an unprecedented level of regulatory and private-sector coordination.

²¹⁶ “Due to constant demand for their use, AI operations have sustained high levels of power needs and demand power availability in excess of 99.9%. Such a level of availability is more than a single generation source (or the grid) can generally provide, and thus redundant power supplies are typically required.” See Cliff Vrielink, Jessica Adkins, & Tiph Kugener, “Five Things to know about Power Supply to Data Centres” (30 January 2025), online: <powermag.com>.

The issues facing regulators and governments are also reflected in the commercial and project issues specific to data centres. Users of data centres will seek to arrange supply and price certainty, achieve voluntary and regulatory emissions reductions goals, and maintain performance standards. Data centres will also introduce unique commercial risks associated with ramping, load shape, and the hazards of rapid technological innovation, obsolescence and replacement outpacing slower and more deliberate energy facilities investments. New customized commercial terms will have to be developed to allocate and mitigate these bespoke risks.