COLUMBIA | SIPA
School of International and Public Affairs

CAPSTONE FINAL REPORT · APRIL 2026

Managing Data Center Load Growth in New York State

Recommendations for NYSERDA on Large-Load Data Center Interconnection for Grid Reliability, Ratepayer Protection, and Decarbonization

Advised by Anastasia Roy

Prepared by:
Manager: Josh Argentine
Deputy Manager: Luke Piazza
Team: Erica Albert, Alicia Carmona Cornejo, Heshan Chen, Maxwell Howland, Leah Ndumi Kioko, Kapil Kumar Narula, Ansha Pathak, and Anders Spittal

Table of Contents

List of Abbreviations

Abbreviation	Definition
BESS	Battery Energy Storage System
CPU	Central Processing Unit
CRAC	Computer Room Air Conditioning
DC	Data Center
DEC	NYS Department of Enironmental Conservation
DERs	Distributed Energy Resources
DOE	U.S. Department of Energy
ERCOT	Electric Reliability Council of Texas
FERC	Federal Energy Regulatory Commission
GFMs	Grid-forming Inverters
GPU	Graphics Processing Unit
GW	Gigawatt
ISO	Independent System Operator
MW	Megawatt
NYC	New York City
NYISO	New York Independent System Operator
NYPA	New York Power Authority
NYS	New York State
NYSEG	New York State Electric and Gas
NYSERDA	New York State Research and Energy Authority
PJM	Pennsylvania-New Jersey-Maryland Interconnection
PSC	Public Service Comission
PUE	Power Usage Effectiveness
RTO	Regional Transmission Organization
STATCOMs	Static Synchronous Compensators
TENs	Thermal Energy Networks
UPS	Uninterruptible Power Supply
WUE	Water Usage Effectiveness
5GDHC	Fifth-Generation District Heating and Cooling

Executive Summary

This report examines the emerging challenges posed by large-load data centers (DCs) development in New York State (NYS) and provides targeted recommendations for the New York State Energy Research and Development Authority (NYSERDA) to guide this growth in a manner that protects grid reliability, limits ratepayer impacts, and supports decarbonization goals. Prepared as a capstone project for the MPA-ESP program at Columbia University's School of International and Public Affairs and advised by Professor Anastasia Roy, the research was conducted by a 10 member team of graduate students for the use of the New York State Energy Research and Development Authority (NYSERDA).

As electricity demand from DCs is projected to grow rapidly, NYS faces increasing pressure to proactively manage large-load interconnection and system planning. Analysis of the New York Independent System Operator (NYISO) interconnection queue reveals that while total future load remains uncertain, DC development is highly geographically concentrated, increasing the risk of localized grid constraints and costly infrastructure upgrades. At the same time, the policy landscape at both the state and federal levels is rapidly evolving, with growing emphasis on cost allocation, system reliability, and transparency for large-load customers.

To address these challenges, this report identifies three high-impact areas of intervention: (1) promoting data transparency to improve system planning, (2) catalyzing energy efficiency improvements through the adoption of advanced liquid cooling technologies to reduce total load growth, and (3) facilitating demand flexibility to enable DCs to operate as grid-responsive resources rather than fixed demand. These strategies are supported by analysis of best-in-class technologies, case studies, and policy precedents and are designed to be both actionable within NYSERDA’s authority and scalable through coordination with regulators and market operators.

Taken together, these recommendations provide a framework for aligning DC growth with the clean energy and reliability objectives of NYS and the regulators of the NYS grid. By improving visibility into DC operations, reducing their energy intensity, and integrating them more actively into grid management, NYS can minimize the uncertainty and risks associated with rapid load growth while leveraging DCs as a potential asset to the evolving power system.

Background on Data Centers

As the U.S. economy continues to shift to a digital-based service economy, the need for DCs to power that shift and growth is expanding as well. Traditional DCs have existed for decades, powering the internet, storing data, and providing cloud computing services that enable every online platform and tool on which people and organizations rely. However, more recently there has been an explosion of demand for new and larger DCs. In the Department of Energy's (DOE) 2024 Report on U.S. DC Energy Use produced by Lawrence Berkeley National Laboratory, they found that whereas DCs consumed about 4.4% of total U.S. electricity in 2023, their portion of energy demand is expected to grow exponentially to consume approximately 6.7 to 12% of total U.S. electricity by 2028, as can be seen in **Figure 1** below (DOE, 2024). This represents a novel and daunting challenge for the U.S. electrical grid from which NYS is not isolated.

Edge Data Centers

Edge DCs are defined primarily by their power demand, also called their "size," and their proximity to the end-users of their services. They are generally between 100 kW and 5 MW in size. The "edge" in their name comes from the fact that they are physically located near densely populated areas close to the "edge" of the grid where the power they draw is located within the same service area as the end users of the DC's services.

Some edge DCs are referred to as "enterprise DCs" when they are used by a single end-user customer. An example of this would be a securities trading firm having its own servers on a designated floor in the same building as their offices. This close proximity reduces latency and provides greater control over the physical security of their servers. For the purposes of this report, "edge" and "enterprise" will be interchangeable terms when referring to these smaller DCs.

Within the context of NYS, edge data centers are heavily clustered within New York City (NYC). The city's dense population, high demand for computing needs, and limited developable land results in a very high density of edge data centers.

Large-Load Data Centers

The bulk of the research in this report focuses on large-load DCs due to their significant and disproportionate potential for negative impacts on the grid. As a DC's size increases, so do its potential impacts on grid infrastructure and system reliability.

Here "large-load" is defined as any DC with a nameplate capacity, or maximum power draw, of 10 MW or more. The benchmark of 10MW was chosen because it is the capacity above which any data center looking to interconnect to the NYISO grid is required to enter the NYISO interconnection queue and undergo a load interconnection procedure (NYISO, 2022). These facilities generally have large footprints, are usually located in rural areas, and nearly always have fast interconnection, or "speed-to-power," as their largest motivator for siting of new DCs.

Included in the definition of in large-load DCs used here are hyperscale DCs, which are typically larger than 100 MW. Some of the largest facilities globally exceed 1 GW in capacity, equivalent to the electricity consumption of over 800,000 U.S. homes. These facilities may be owned by DC development companies that lease capacity to customers, or they can be owned directly by large technology firms with substantial computing needs, often called "hyperscalers." Major hyperscalers include Amazon Web Services, Microsoft, Google, Meta, and others of the world's large technology companies.

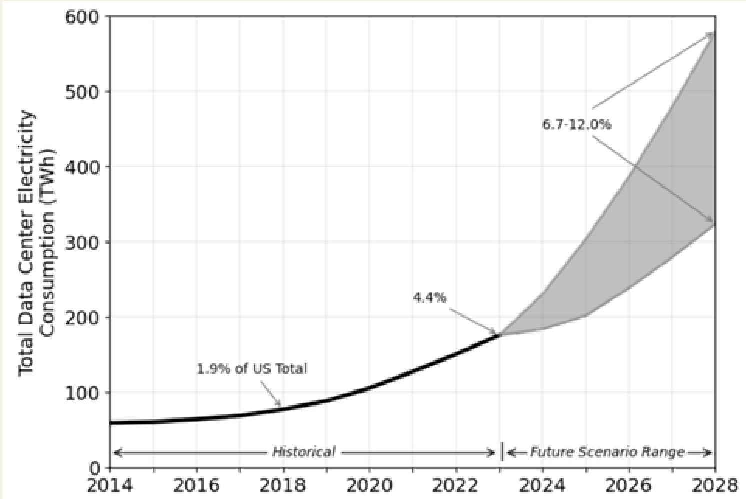

Figure 1: DOE Data Center Energy Consumption Projection

I.

Current State of Data Centers in NYS

NYS is not a hub for hyperscalers or even large DCs. This lack of DC development in the State historically has led to grid planners not previously needing to heavily consider the implications for the grid that come specifically with DC development, instead treating them the same as other large load interconnections which are much more prevalent. However, as DC interconnection accelerates, grid planners must now consider the specific challenges, such as fast ramp rates and inflexible load, that often come with DC interconnection. NYS is not isolated from these challenges that are expected to increase in frequency and intensity for the grid. Governor Hochul's recent directive for the Department of Public Service to overhaul the cost allocation rules from new large-loads interconnecting to the NYS grid highlights the expectation that the trend of increasing DC development is expected to have major implications for the NYS grid.

The first step in crafting recommendations for NYSERDA's reducing the impacts and maximizing the benefits of new large-load interconnection of DCs was to first gain an understanding of the current state of DC interconnection in the NYISO service area through data gathering and analysis. This analysis includes two parts: The first half incorporates policy and legislative review to better understand the current possible upcoming rulings under which new DCs must operate in NYISO's jurisdiction. The second half analyzes the NYISO interconnection queue, which provides information regarding projects planned or in development that are requesting to connect to the NYISO grid. Together these form the basis for understanding the current baseline condition of the NYS grid for further analysis in this report.

I.I. Policy and Legislative Review

Oversight of DC interconnection is a rapidly emerging policy concern for both federal and New York State policy. DCs' focus on speed-to-power and the projected exponential increase of DC power demand in the next decade or less have resulted in policy makers scrambling to put rules in place to protect their interests. Private interests and federal regulations are focused on expediting DC interconnection, which competes directly with NYS regulatory priorities of grid stability and ratepayer protection. This has resulted in divergent policy objectives of enacted and proposed legislation and regulatory policy. Many of these policies and regulations are still evolving and uncertain as policy makers and grid operators seek clarity on the rules that they will need to operate under as interconnection of DCs to the grid continues to expedite.

NYS Legislative and Policy Landscape

New York's emerging approach to large DC loads has become a prominent political issue, shaped in part by Governor Hochul's recent State of the State address on January 13th, 2026, in which she announced the Energize NY Development initiative. The initiative directs New York's PSC, to overhaul interconnection rules, tariffs, and cost allocation so that large loads, such as large-load DCs, either fully internalize grid-upgrade and reliability costs or develop their own dedicated energy supply ("Governor Hochul Unveils Ratepayer Protection Plan", 2026). It also reflects growing concern that DCs do not generate enough jobs and local economic benefits to justify the strain they place on the grid and on other customer classes. In addition, NYS Bill S9144 was introduced on February 6th and, if passed, would establish a three-year-plus-90-day moratorium on new data-center permits while the Department of Environmental Conservation (DEC) prepares a generic environmental impact statement and the PSC evaluates rate impacts and potential measures to protect other customers from DC-driven cost increases (The New York State Senate, 2025).

Fights over DC development in NYS have also spilled into national politics: in December 2025, more than 50 organizations from New York signed a letter to Congress calling for a nationwide moratorium on DC development, indicating a push back against data centers throughout the State.

CASE STUDY — LANSING, NY

TeraWulf, a DC developer, proposed an 80-year lease for a 400-MW data center at a former coal-fired power plant in Lansing, New York. The proposal drew intense pushback from residents, including calls for a town-level moratorium on construction (Dalban, 2025). After a contested review process, the Town Board ultimately approved the project in January 2026, backed by union members and business leaders who argued that the facility would bring much-needed jobs to the region.

CASE STUDY — ALABAMA, NY

Similar dynamics emerged in Alabama, New York, where a proposed 500-MW data center faced opposition from the Tonawanda Seneca Nation and local residents. Legal challenges led to the rescinding of initial approvals. Ongoing concerns focus on environmental oversight and the role of local authorities in the permitting process, reflecting broader uncertainty around governance and siting decisions for large-load facilities (Orleans Hub, 2025).

Federal Legislative Landscape

State lawmakers nationwide have advanced legislation to shape DC interconnection timelines, with policies aimed at either expediting or restricting development. In contrast, federal legislation has remained largely stagnant. There have been no recent major pieces of legislation to govern how this issue should be handled, and there are no bills currently that appear to have significant momentum. **Table 1** outlines the bills that have been introduced in the last several months; each of these remain in committee and do not show any clear signs of being passed. H.R. 5227 is the only recent bipartisan bill introduced, which reduces obstacles for DC growth in rural regions.

I.I. Policy and Legislative Review

Table 1: Recently Introduced Federal Legislation on Data Centers

Bill	Introduction	Key Provisions
H.R.6984	1/8/26	Requires reports on the effects of DCs on air and water quality, and on electricity consumption
S.3682	1/15/26	Creates DC load queues and DC-specific rate classes, increases federal oversight
H.R.6529	12/9/25	Requires FERC to hold a conference on protecting ratepayers fom increased costs associated with large loads and submit a best practice report
H.R.5227	9/9/25	Conducts a study on the impact of AI and DC site growth on energy supply and whether updates to existing energy infrastructure are needed to support co-location of AI and DC development. Expedites review under the National Environmental Policy Act. Prioritizes AI and DC in rural areas.

Federal Agencies: DOE and FERC

The DOE has shown a clear desire to expedite the connection of new large-load customers to the grid. As of October 23, 2025, they have directed the Federal Energy Regulatory Commission (FERC) to initiate new rulemaking proceedings in order to “rapidly accelerate the interconnection of large-loads” (White & Case, 2025). This initiated an expedited rulemaking process at FERC. The results of this expedited rulemaking are expected to be delivered April 30th, 2026, and they will likely reframe how NYISO must handle requests for new DC interconnection.

In addition to initiating new rulemaking proceedings, the DOE outlined desired changes in DC policy. A major point is the attempt to expand FERC’s control over new interconnection of large-loads. This is a power that has not typically fallen to federal authority. The DOE has stated that the interconnection of large-loads should be handled similarly to generation interconnection, of which FERC has typically had larger oversight. The outcome of this ruling is heavily expected to be challenged in court, especially if it serves to expand federal control over interconnection for DCs, as has been directed by the DOE (Humes, 2026).

On December 18, 2025, FERC issued an order to PJM, the regional transmission organization (RTO) for the mid-atlantic, requiring them to create clear rules for large-load customers to be able to colocate with generation (Crosley, 2026). This aims to make it easier for DCs and other large-load customers to connect directly to existing power plants or to bring their own generation. This represents a forced overhaul of PJM’s regulations regarding behind-the-meter generation and provides a way for quicker speed-to-power for large-load customers. FERC specified three different connection options that large-load customers can choose from for setting up co-located generation, and it requires PJM to establish guidelines for large-load customers looking to utilize these strategies rather than entering the interconnection queue. While the expedited rulemaking is likely to be broader in scope, it could seek to establish similar process standardization for DC interconnection nationally.

Furthering this trend of federal interest in DC interconnection, on April 9th of this year, the DOE’s Energy Information Administration sent letters to U.S. Senators Elizabeth Warren (D-MA) and Josh Hawley (R-MO) informing the senators of their intention to conduct a mandatory survey of all U.S. DCs to gain a better understanding of their energy usage (Warren, 2026). This latest development continues to highlight the trend of rapid evolution in the regulatory landscape around DCs.

I.I. Policy and Legislative Review

Outlook for NYISO and Ratepayers

NYISO is well aware of the issues that DCs have the potential to bring to the grid for ratepayers. They already have in place Large Facility Interconnection Procedures which require a feasibility study to be undertaken before any new large-load (above 20MW) can interconnect to the grid (New York Independent System Operator, 2017). If it is determined that transmission upgrades are required to meet the new energy demand, the costs associated with these upgrades are assigned to the large-load looking to connect.

These rules, however, were not designed for the current intensity of DC interconnection that many regions of the U.S. are seeing. As a result of Governor Hochul's Energize NY Development initiative, PSC Case 26-E-0045 (*Proceeding on Motion of the Commission to Address Interconnection Reforms for Large Loads)* is currently open and active with the goals of updating these guidelines appropriately to account for the realities, in transmission upgrades and cost allocation, of the current situation.

The evolving political landscape surrounding DCs has the potential to change some of these procedures for NYISO. For instance, if FERC expands its ruling regarding colocating generation with DCs to all Independent System Operators/Regional Transmission Operators (ISOs/RTOs) in its purview, DCs in NYS may be able to side step some of these requirements. However, Governor Hochul's announcement that she wants New York's PSC to review how costs associated with DCs are affecting ratepayers, along with the possible passing of the moratorium on new DC builds, could end up stalling or stopping new DC interconnection.

There is some push from federal legislation to impose laws relating to how DCs must handle their emissions, costs to ratepayers, and environmental impact, however none have gained significant traction as the current administration clearly believes that quicker DC interconnection is needed. There is a clear friction between federal and state/local objectives which limits understanding on ultimate resolution of the situation.

Image 1: Rural hyperscaler data center cluster

I.II. The NYISO Interconnection Queue for Data Centers

Interconnection Queue Data

~11,900 MW

Total large-load projects in NYISO queue

~5,700 MW

Identified as Data Center projects (~48%)

Clustered Load

Two-thirds of identified DC load in the queue is concentrated in just 3 counties

The NYISO interconnection queue contains a total of around 11,900 MW large-load projects (NYISO, 2026). These projects include both data center–identified and non-DC facilities. Of the total large-load capacity, approximately 5,700 MW (~48%) are explicitly identified as DC projects in the NYISO disclosure. Focusing specifically on the large-load projects marked as DCs, the total load is geographically concentrated in a small number of NYISO zones.

Zone A accounts for the largest share at around 1,500 MW (27%), followed by Zone E at 1,233 MW (22%), Zone H at 1,200 MW (~20%), Zone C at 860 MW (15.0%), Zone D at 496 MW (~9%), and with a smaller 250 MW (~4%) straddling Zones D/E and 132 MW (~2%) in Zone G. This indicates (see **figures 2** and **3** below) that more than two-thirds of identified large-load DC load is concentrated in Zones A, E, and H alone.

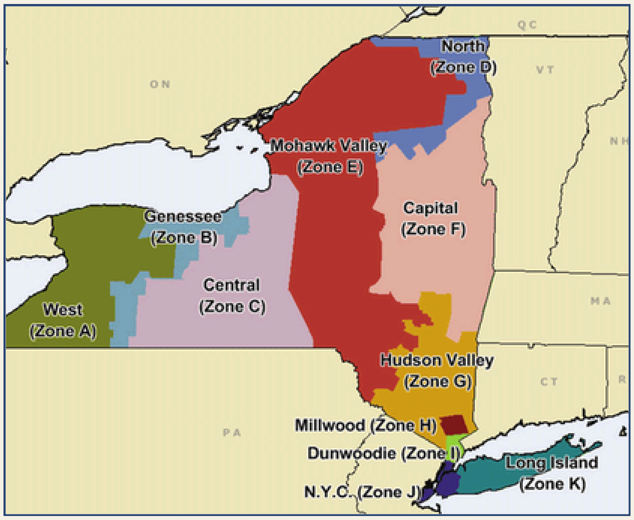

Figure 2: Demand zones of the NYISO power market

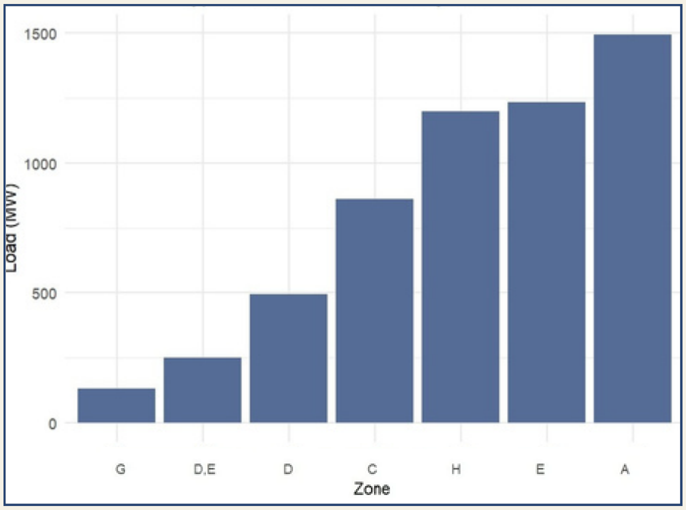

Figure 3: Zone-wise distribution of data center large load interneconnection requests

I.II. State of the NYISO Interconnection Queue for Data Centers

At the county level, the concentration is even more pronounced. St. Lawrence County represents 1,979 MW (~35%), representing over one-third of all identified large-load DC load. Dutchess County follows with 1,000 MW (17.5%), and Niagara County with 896 MW (~16 %). The rest of the counties including Erie (300 MW), Onondaga (300 MW), Niagara Falls (300 MW), Yates (260 MW), Tompkins (250 MW), and Westchester (200 MW), each account for between roughly 3–5% of load. **Figures 4** below indicates that large-load DC projects are highly clustered, with roughly two-thirds of capacity located in just three counties.

In terms of the interconnecting utilities for DCs, The New York Power Authority (NYPA), with 2,079 MW represents the largest utility exposure, followed by Con Edison (1200 MW), and New York State Electric and Gas (NYSEG) (1,060 MW). National M-NG (696 MW), National Grid (500 MW), and Orange & Rockland (O&R) come in with smaller contributions. **Figure 5** below gives the distribution of this load.

Overall, the identified large-load DCs in the NYISO interconnection queue are both regionally concentrated and transmission-specific, with heavy clustering in Zones A, E, and H, particularly in St. Lawrence, Dutchess, and Niagara counties, and relatively significant exposure to NYPA, National Grid, and NYSEG utilities. These zones and utilities will likely incur higher costs and require careful upgrade planning.

If multiple projects proceed simultaneously in one area, larger upgrades may be necessary at scale, even if individual projects would have been manageable. Interconnection bottlenecks also pose challenges; studies have shown that upgrade costs are often prohibitive, causing projects to drop out (U.S. Department of Energy, 2023; Lawrence Berkeley National Laboratory, 2023). Conversely, early upgrades for a primary project can reduce costs for subsequent projects and influence future project locations (Interstate Renewable Energy Council, 2021).

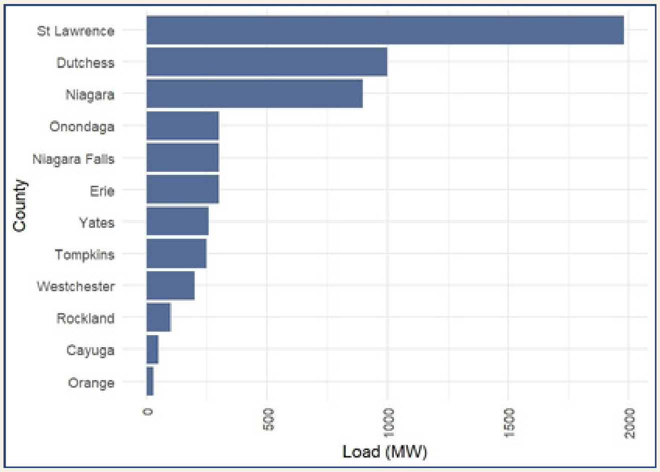

Figure 4: County-wise distribution of data enter large load interconnection requests

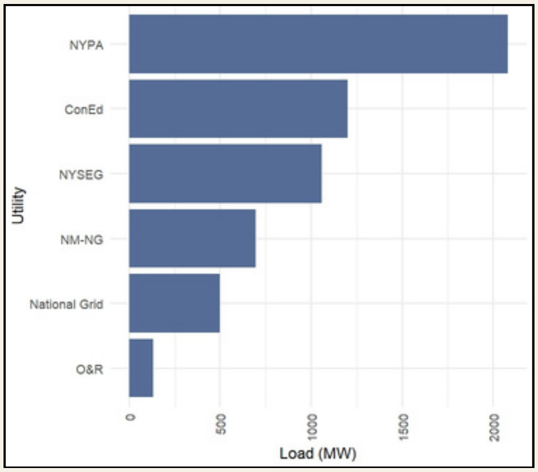

Figure 5: Utility-wise distribution of data center large load interconnection requests

I.II. State of the NYISO Interconnection Queue for Data Centers

Interpreting Interconnection Queue Data for NYS

The NYISO interconnection queue is a key dataset for understanding large-load development in NYS, but it does not provide a reliable estimate of future DC demand. As shown in Appendix B, there 570% difference between NYISO's projected growth of large-load demand in the their service area and the current amount of large-load demand in the NYISO queue. This intruduces large amounts of uncertainty and makes projected load growth extremely difficult.

Total Queue Size Is Not a Reliable Forecast

The approximately 11.8 GW of large-load projects reflects requested capacity, not expected buildout. Developers often submit multiple or oversized interconnection requests to preserve optionality, and there is no reliable dataset tracking realization rates for large-load projects. As a result, a meaningful share of queued capacity is unlikely to materialize or will be delayed or reduced in scale. For NYS planning, this limits the use of total queue MW as a standalone input for load forecasting or infrastructure sizing.

Limited Visibility into Timing and Grid Impact

Queue data provides little insight into project readiness or timing. Information on financing, permitting status, and development progress is not disclosed, making it difficult to distinguish near-term projects from speculative entries. In addition, the queue reflects only nameplate capacity and does not capture how facilities will operate. Key factors such as phased buildout, utilization, and load profiles are not included, limiting the ability to assess actual grid impact.

Geographic Clustering Is the Most Actionable Signal

The queue shows a high concentration of projects in Zones A, E, and H and in a small number of counties. While total load remains uncertain, this clustering is a consistent and actionable signal. For NYS, this suggests that localized grid impacts are more likely than system-wide constraints. Planning efforts should therefore prioritize managing concentrated load growth in these areas, rather than relying on aggregate statewide projections.

II.

Best-In-Class Analysis

Having established above the backdrop of the DC landscape in NYS within which NYSERDA operates, this section zooms out from NYS and focuses on best-in-class technologies and operating strategies for DCs across the U.S. Many of these technologies have the ability to provide multiple benefits to the grid while mitigating many of the risks associated with large-load DC interconnection. Through this lens, NYSERDA can understand how specific technologies, in either isolation or tandem, can best improve the aspects of the grid and overall energy demand that on which DCs are likely to have the largest impact.

The analysis is organized by grid characteristics that these technologies and strategies have the ability to address, including waste heat reuse, power quality stabilization, grid reliability contributions, energy efficiency improvements, and emerging technologies. The analysis of these technologies and strategies will be key to developing recommendations that are actionable and impactful for the NYS grid.

Best-In-Class Analysis

II.I. Waste Heat Reuse

NYC's existing DCs are smaller, often air-cooled colocation facilities usually embedded within commercial buildings. These edge sites illustrate both the technical challenges and the proximity advantages of urban heat reuse. At the same time, rural, upstate DCs in NYS show potential for heat reuse in larger volumes, although the scale and type of facilities that ultimately locate in the state remains uncertain. Breaking momentarily from this report's focus on large-load DCs, NYC edge DC examples are included to assess technical feasibility in dense urban environments, (Uptime Institute, 2025; Gardiner, 2024).

Large-Load DC Waste Heat Reuse

Large upstate DCs may offer opportunities for waste heat reuse when located near compatible thermal loads such as industrial facilities, campuses, or wastewater treatment plants. Facilities at scales of ~5-10 MW IT load or larger can generate sustained low-to-medium temperature heat that can potentially be captured through heat-recovery systems and used within a short distance, typically within 1–3 km, of the DC (Gardiner, 2024; Wirtz et al., 2020).

In these types of locations, waste heat can be used by nearby industrial or institutional facilities if heat-recovery infrastructure is incorporated during the initial design rather than added later (David Gardiner & Associates, 2025). However, these opportunities remain highly site-specific and depend on the presence of nearby thermal demand, compatible infrastructure, and long-term agreements between facilities. Since waste heat must be used close to where it is generated, sparsely populated rural areas generally lack the consistent thermal demand required for heat-recovery infrastructure. As a result, waste heat reuse is unlikely to drive DC siting decisions on its own, but may provide incremental benefits in locations where suitable heat users already exist. These neccessary conditions and their respective importances to large-load DC waste heat resuse are broken down in the chart below.

Table 2: Necessary Conditions for Viable Waste Heat Reuse Opportunities

Condition	Requirement	Why it Matters
DC scale	~5-10 MW IT load or larger	Generates steady, usable heat output
Proximity to demand	Within ~1-3 km of industrial facilities, campuses, or wastewater plants	Heat transport over longer distances inefficient and costly
Infrastructure timing	Integated at initial design stage	Retrofitting is costly and rarely feasible
Location context	Areas with consistent, year-round heat demand	Ensures sustained utilization of recovered heat

Best-In-Class Analysis

II.I. Waste Heat Reuse

Edge DC Waste Heat Reuse in NYC

NYC's DC market is dominated by small and micro facilities in carrier hotels and colocation buildings rather than by large-load or hyperscale campuses, so most sites produce low-grade waste heat in dense mixed-use neighborhoods (Mordor Intelligence, 2026). Fifth-generation district heating and cooling (5GDHC) is well-suited to this landscape because it uses ambient-temperature water loops (10-25°C) and decentralized heat pumps, align with the low-grade heat that these DCs already produce (Boesten et al., 2019; Buffa et al., 2019). At the same time, uncertain natural gas prices and Local Law 97 penalties create a strong theoretical value for each megawatt-hour of heat reused, making NYC one of the few U.S. cities where low-temperature urban heat networks could pencil out.

However, the same urban context also creates headwinds: new thermal pipes are expensive ($1,500-3,000 per meter), many facilities are small and air-cooled, ownership is fragmented, and no North American 5GDHC project anchored by DCs has been built to date. In practice, this means waste heat is unlikely to shape where DCs are built in NYC. Instead, waste heat reuse opportunities are most likely to occur where suitable DC thermal load already exists near pre-existing thermal demand and retrofit opportunities make economic sense. As a result, any near-term efforts are likely to be carefully scoped pilots rather than city-wide systems (Uptime Institute, 2025; Wirtz et al., 2020; Gjoka et al., 2023).

Key Barriers to Waste Heat Reuse

DC waste-heat reuse in NYS is technically feasible but highly constrained by both structural and market barriers. The State does not require evaluation of participation in Thermal Energy Networks (TENs) during siting, and there is no standardized compensation structure for exported heat. Developers also lack consistent data on nearby thermal loads, making it difficult to identify viable projects. Even where opportunities exist, contractual and reliability concerns persist, as off-takers often require backup systems in case of reduced operations or termination of heat supply agreements.

As a result, waste heat is unlikely to play a primary role in DC siting decisions, which are more strongly driven by factors dictating time-to-power such as electricity availability, transmission capacity, land use, and permitting timelines. This is especially true for large-load DCs whose facilities are generally located in rural areas far away from any concentrated thermal demand. Large-scale waste heat reuse's role is therefore limited and location-specific, providing incremental efficiency benefits only in cases where suitable thermal demand already exists nearby.

Image 2: Visualization aid for waste heat resuse

Image 2: Waste Heat Reuse (Source: Mechanical Mind)

Best-In-Class Analysis

II.II. Power Quality Stabilization

Power quality of the grid dictates the stability of voltage and frequency throughout the grid, and it is key to avoiding blackouts and ensuring reliable access to power. However, degradation of power quality is a negative grid impact that is oftentimes associated with DC interconnection. DCs that employ parallel processing can cause dramatic irregular demand cycles as thousands of processors draw power simultaneously. The resulting demand fluctuations (pictured in **Figure 6**) cause distortions to power quality that seriously challenge grid stability (Lachance). State- of-the-art DCs mitigate this strain on grid equipment and minimize broader reductions in power quality by utilizing proven technologies, such as the ones detailed below, as part of their uninterruptible power supply (UPS) systems.

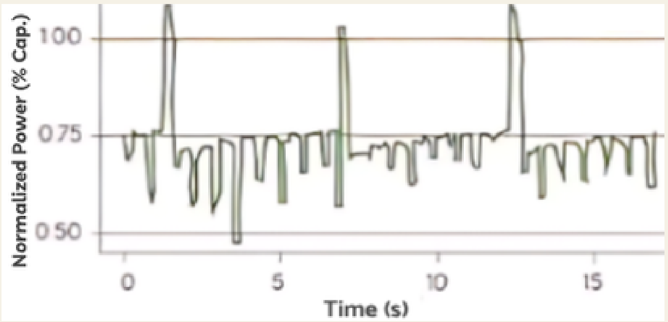

Figure 6: Hypothetical power demand profile for DC without a BESS and supercapacitor-integrated UPS

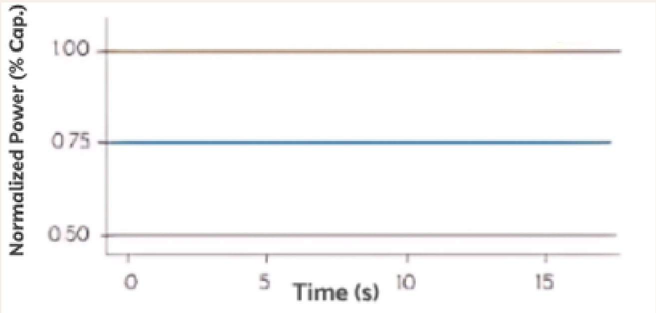

Figure 7: Hypothetical power demand profile for DC with a BESS and supercapacitor-integrated UPS

BESS and Supercapacitors

When DC UPS systems are coupled with BESS and supercapacitors, system electronics regulate power flow between the grid and DC infrastructure, filtering out harmonic distortions and voltage fluctuations. The combination of these technologies serves a dual purpose; acting as an instantaneous layer of protection for DC compute equipment against disturbances, and allowing the grid to supply power directly to the UPS system via a smooth current wave. The resultant improvement in facility power factor both reduces customer demand charges and improves overall system performance. Pictured in **Figure 7** are the positive effects that the combination of these two technologies have on DC power quality.

Other Power Quality Stabilizing Technologies

Additionally, DCs or regulators seeking to improve power quality can do so through the integration of grid-forming inverters (GFMs), dynamic volt-ampere reactive support devices such as static synchronous compensators (STATCOMs), and higher-voltage interconnections. GFMs provide autonomous voltage/frequency regulation and virtual inertia, minimizing the effects on power quality of ramp-induced fluctuations in instantaneous demand (Rathnayake et al., 2021). STATCOMs deliver rapid reactive power to mitigate dips and inductive distortions, preserving waveform integrity (Kishore & Reddy, 2014). Higher-voltage links strengthen short-circuit capacity and stability, curtailing losses of energy as heat and distribution vulnerabilities (Zhang et al., 2025; von Meier, 2006). Collectively, these technologies ensure compliant sinusoidal power, minimizing harmonics and outages.

When deployed together, these technologies effectively transform high variability DC load into a smooth demand profile at minute to minute resolution. The grid supplies power in a clean waveform, thus increasing the power quality, and the DC receives power without harmonic distortions and power transients, thus protecting their compute equipment.

Best-In-Class Analysis

II.III. Grid Reliability Improvements

To help grid operators manage rapidly rising electricity demand, state-of-the-art DCs increasingly operate as active participants in maintaining system reliability. Many facilities deploy DERs or adopt bring-your-own-capacity approaches to supply a portion of their electricity needs, often paired with BESS capable of providing ancillary grid services. In addition, DCs may enter into flexible interconnection agreements (Brancucci et al., 2025) and participate in demand response programs, allowing operators to reduce or shift load during periods of system stress. Individually or in combination, these approaches help to minimize the stress that a DC puts onto the grid and contribute to improved reliability of the grid as a whole.

Peak Shaving and Load Shifting

During periods of peak demand, modern DCs can play an important role in supporting grid reliability by actively managing their load (Ross & Ewing, 2026). In this context, peak shaving and load shifting are key operational strategies.

Peak shaving requires DCs to reduce their grid draw during high-demand periods by relying on on-site generation or stored energy, while load shifting requires them to shift (or move) energy-intensive operations to off-peak periods. These are achieved through investment in on-site DER resources such as solar, wind, and batteries, as well as through flexible operating strategies.

During periods of system stress, DCs together with these paired peak-shaving and load shifting strategies may participate in ancillary service markets, providing rapid injections or withdrawals of power, or reduce demand through internal load management. These capabilities reduce reliance on costly peaking generation and help defer infrastructure upgrades, while allowing ISOs and utilities to maintain reliability more efficiently. They also help mitigate the risk of stranded assets, where long-lived generation resources are developed to serve temporary or uncertain DC demand, and provide a complementary, grid-integrated mechanism through which DCs can further contribute to system flexibility and reliability, as discussed in the following section.

Demand Response Programs

Demand response programs further enable DCs to enter into flexible grid connection arrangements, thereby contributing to grid reliability by agreeing to flexible, dispatchable load reductions. Under these programs, DCs agree to employ peak shaving or load shifting strategies in response to signals from grid operators during periods of high demand or system stress.

Participation in demand response is often facilitated through flexible interconnection arrangements, such as conditional firm service agreements, where a portion of a DC's load may be curtailed under predefined conditions. In return, operators receive more favorable interconnection terms.

For utilities and ISOs, the participation of large-load customers in demand response programs can significantly reduce the need for new generation and transmission investments (Branucci et al., 2025). It can also support clean energy integration by enabling greater renewable energy deployment. For DCs, these programs provide operational flexibility and cost savings while supporting broader grid stability and allow operators to maintain service continuity by leveraging on-site load shifting arrangements during curtailment events.

Overall, demand response complements DERs and BESS strategies by providing an additional, system-level mechanism for balancing supply and demand, particularly during peak conditions.

Best-In-Class Analysis

II.III. Grid Reliability Improvements

Figures 8 and 9 below illustrate how peak shaving and load shifting measures change data center load profiles to reduce system load at peak periods.

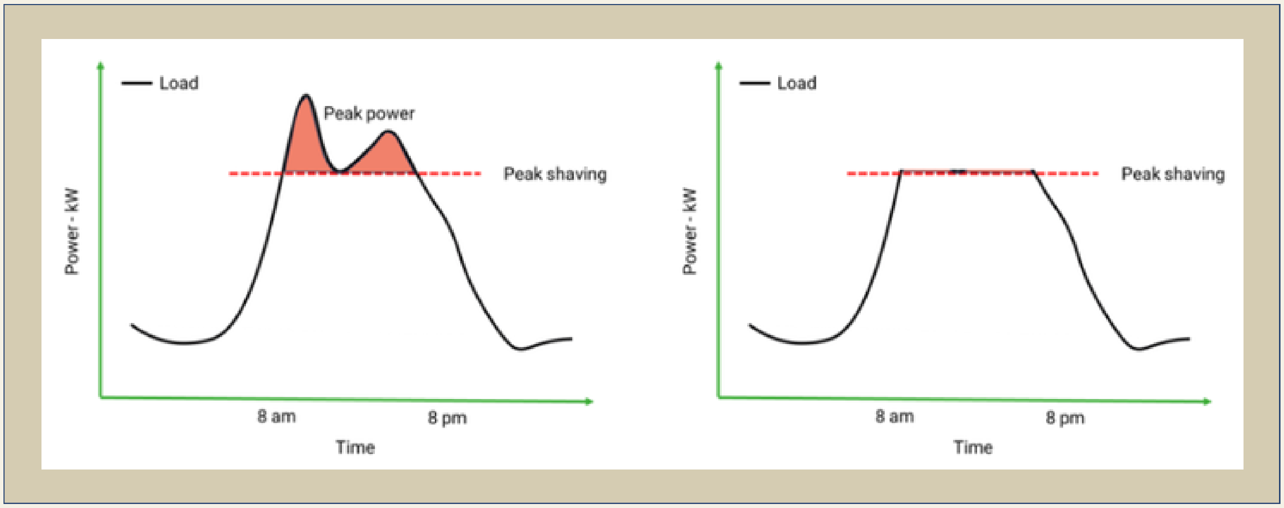

Figure 8: Diagram of load before and after peak shaving strategies are employed (Source: Power Sonic)

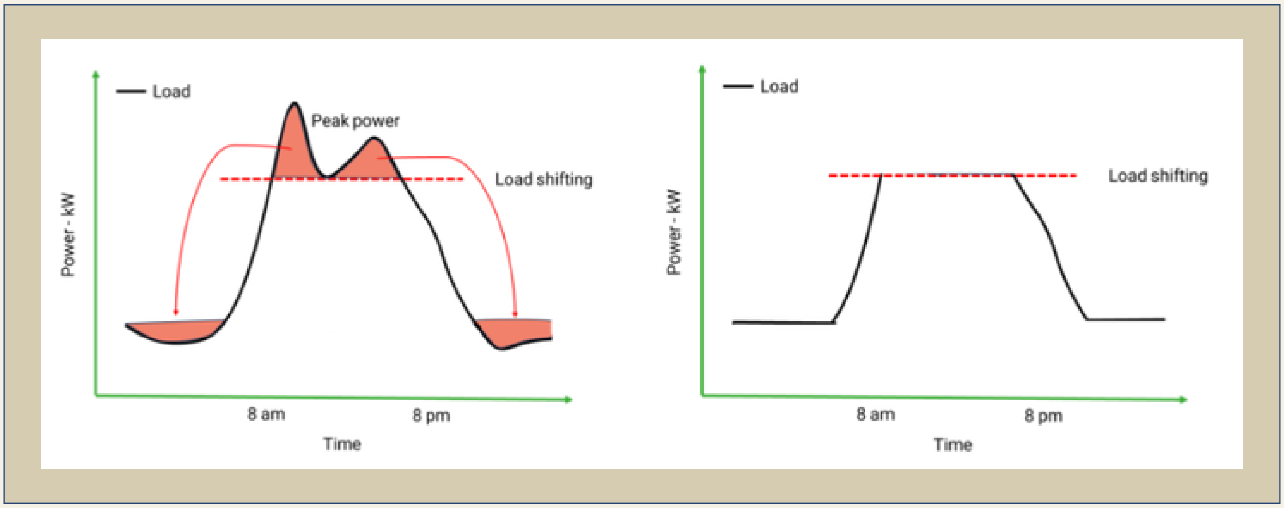

Figure 9: Diagram of load before and after load shifting strategies are employed (Source: Power Sonic)

Best-In-Class Analysis

II.IV. Energy Efficiency Gains

Cooling in DCs accounts for up to 40% of energy use (UCSD, 2025). Transitioning from traditional air cooling, commonly called computer room air conditioning (CRAC), to liquid cooled systems has shown to reduce total facility energy consumption by over 25% even in non-optimized designs (Boydcorp, n.d.). This shift from CRAC systems to liquid cooling represents the largest opportunity by far for DCs to improve the energy efficiency of their operations.

LIguid Cooling

A technology-specific study tested cold plate technology and two forms of immersion cooling and found a reduction of greenhouse gas emissions by 15 to 21% and water usage by 31 to 52% (Data Center Dynamics, 2025). Transitioning to these liquid cooling technologies allows DCs to minimize their negative environmental impacts while also saving money on their ongoing energy costs of operation.

Liquid cooling refers to a set of heat management technologies in which a coolant liquid is circulated directly to heat producing electrical equipment such as CPUs and GPUs to efficiently remove heat. Liquid cooling differs from traditional CRAC cooling by transporting a liquid directly to computing electronics reducing total load at all levels of demand, including peak. These systems minimize the strain on local grids as well as the reducing required grid upgrades needed to support DC load. Specific technologies that can be deployed in favor of CRAC system are detailed below.

Table 3: Overview of Liquid Cooling Technologies for DCs

Technology	How it Works	Best Use Case	Key Advantages	Key Constraints
RDHc (Rear Door Heat Exchangers)	Rack door replaced with liquid-cooled heat exchanger	Retrocits, edge DCs	Compact, easier integration into existing facilities	Less efficient than other liquid cooling systems
Direct-to-Chip (D2C)	Coolant flows through plates in direct contact with chips	New builds, high-density workloads (AI)	High energy efficiency, supports higher compute density	Requires custom design, more complex infrastructure
Immersion Cooling	Hardware fully submerged in coolan	Emergin deployments, high-performance use cases	Highest efficiency, easier thermal management	Limited adoption, still maturing technologies
Dynamic Liquid Cooling	Control adjusts coolant temperature and flow in real time	Can be paired with any liquid cooling system	Improves efficiency, reduces energy use and emissions	Requires advanced controls and system integration

Best-In-Class Analysis

II.V. Emerging Technologies

AI-Enabled Demand Response Through Workload Orchestration

At the fleet level, hyperscalers such as Google and Microsoft use AI-based workload schedulers to shift flexible jobs across time and space. Initially intended for emissions reduction, these systems are increasingly being used to align compute demand with grid conditions, redirecting workloads to where and when power is less constrained and reducing stress on local grid nodes. At the site level, emerging platforms demonstrate how workloads can be dynamically adjusted in response to grid signals. Early pilots suggest that coordinated workload management can reduce demand during peak periods while maintaining performance for latency-sensitive services.

CASE STUDY — EMERALD AI & EPRI DCFLEX

In EPRI's DCFlex program in Phoenix, Arizona, and in a National Grid pilot in the United Kingdom, AI-enabled workload management platforms were tested in live data center cluster environments. These systems enabled operator-requested load curtailment by dynamically adjusting data center workloads in response to grid signals. Results from these pilots indicate that flexible data center loads can achieve operationally relevant response times within short timeframes without compromising latency-sensitive services (Spieler, 2025; National Grid, 2026).

Flexible demand contracts used in concert with emerging AI demand response technologies can make these contracts even more compelling to DC developers than accelerated interconnection timelines. Emerging technologies in this field offer a potentially dramatic shift in DC operations, coordinating compute workloads and broader power demand with direct grid signals. Additionally, time and geographic redistribution of AI workloads through coordinated workload management has been shown to reduce power use by roughly 25% during peak demand periods while maintaining compute performance (Stanton, n.d.). AI enabled demand response can even result in reductions in carbon intensity of compute operations when AI tools are able to identify DCs in their network that are currently operating on lower carbon electricity (Koningstein, 2021).

AI-Assisted Control of Onsite Assets for Resilience

In proposed AI campuses, advanced AI-assisted microgrid controllers use real-time forecasting and optimization to coordinate on site batteries, generators and critical cooling loads during disturbances. This allows facilities to disconnect smoothly and resync without abrupt trips, thus facilitating minimal power disruptions in the event of external disturbances (Marshall, n.d.). When utilized together, these technologies allow DCs to maintain critical operations during disruptions while supporting grid operators in stabilizing and restoring broader operations in the wake of natural disasters, cyberattacks, or large-scale equipment failures (Yan et al., 2024).

Fuel Cells

Fuel cells are an additional category of DER that can further contribute to peak-shaving DC demand. While these technologies are still relatively nascent due to their high costs and low total deployment, they have begun to scale as a viable source of on-site generation for DCs. Notably, there are already over 400 MW of fuel cells deployed at DCs globally (Bloom Energy, n.d.). If paired with an electrolyzer, on-site storage for hydrogen gas, and connection to natural gas pipes, fuel cells have the ability to be a multi hour/day solution to slot in behind BESS systems as a potentially zero-emission, behind-the-meter generation solution that can protect ratepayers while lowering DC carbon intensity. While this green hydrogen fuel cell setup is relatively far from widespread adoption due to lack of commercial viability, small trials for research and optimization have the potential to give researchers a better understanding of how to position the technology in the future for the grid.

III.

Key Recommendations

The research above has been presented to provide context and insight on both the challenges and potential solutions for the issues that are likely to arise from interconnection of new large-load DCs in NYS. The findings from this research have been distilled into three key recommendations that are both highly impactful and highly actionable.

Key areas of intervention were chosen based on their ability to mitigate increases in emissions, rates for ratepayers, and grid instability as a result of DC interconnection. Some of these solutions and strategies are broad and may be out of the scope of NYSERDA-led programs. However, these are still included in their entirety with the understanding that while NYSERDA may not be able to implement all interventions itself, it can certainly still play a role in research and advocacy for best practices in handling new DC interconnection.

The first key recommendations for NYSERDA is to promote the data transparency of operational DCs and DCs in the interconnection queue in order to better enable grid planners and operators to plan for and address system challenges. Second, NYSERDA is encouraged to help catalyze energy efficiency through liquid cooling technologies that have the potential to lower overall power demand of DCs on the NYS grid. Last, the organization should facilitate demand flexibility in DCs through targeted incentives, conditional program eligibility, and high-impact demonstration projects. As is explored below, these strategies together represent a holistic approach to mitigating the uncertainty and risk asociatted with new large-load DC interconnection in NYS.

KEY RECOMMENDATIONS

III.I. Overview of Recommended Areas of Intervention

NYSERDA's mission is to "catalyze New York's clean energy transition" and its vision is for "clean energy that supports a healthier and thriving future for all New Yorkers" (NYSERDA, 2026). These have been used to guide research and recommendations in a way that aligns with the goals of protecting ratepayers from rate increases due to DCs and minimizing the impact that DC load growth will have on the carbon-intensity of the NYISO grid.

The chart below provides a high-level overview of the report's recommendation areas, the specific strategy recommended, the method of implementation for each strategy, a justification for implementation, a breakdown of NYSERDA's role in implementing the strategy, and the counterparties and stakeholders that will likely need to be included in planning and execution of the recommended strategies.

Table 4: Summary of Recommendations and Institutional Roles

Recommendation Area	Strategy	Implementation Method	Why it Matters	NYSERDA Role	Requires Coordination
Promoting data transparency	Reporting	Standardize current or planned facility energy use reporting	Enables planning, policy desing, and accountability (NCEL, 2025)	Framework design, pilot through programs	PSC, NYISO, DEC (requirements, data collection)
Catalyzing energy efficiency improvements	High-efficiency cooling	Scale liquid cooling and dynamic thermal management	Cooling account for ~30-40% of energy use; upgrades can reduce emissions ~25% (Gheni et al., 2026	Incentives, pilots, technical guidance	Utilities (programmatic alignment)
Facilitating demand flexibility	Flexible load	Enable demand response and AI-mediated load shifting	Reduces peak demand and marginal emissions (Stanton, n.d.)	Incentives, demonstration projects	PSC, NYISO (tariffs, interconnection)

KEY RECOMMENDATIONS

III.II. Promoting Data Transparency

The promotion of data transparency is the foundational step that will allows for the facilitation of the remaining recommendations. More transparent data disclosures from DCs seeking interconnection are key for grid planners to more accurately forecast load and to accurately plan new generation, transmission, and distribution assets accordingly.

Additionally, once DCs are operating, limited and inconsistent data on DC energy use and operations constrains NYS's ability to assess system impacts, track emissions, and design effective policy responses. While NYSERDA does not have the authority to mandate data disclosures from DCs, it is well positioned to research and recommend the key data points and metrics that are most salient for grid planners and operators. Having this information accessible will allow the NYISO grid to expand in a manner that can be appropriately planned for ahead of time and thus reduce grid stress, ratepayer burden, and emissions intensity of the NYS grid.

Currently, NYS does not require standardized, facility-level reporting of DC energy, water, or emissions data; existing visibility is largely derived from aggregated utility data or voluntary disclosures, limiting the State's ability to plan for rapid load growth. This gap is increasingly consequential as DCs are expected to drive a significant share of electricity demand growth and could contribute to rising system costs and reliability challenges without improved visibility (NCEL, 2025).

Improving transparency is a foundational step for aligning DC growth with the state's energy and climate goals. Standardized reporting would enable grid planners and regulators to accurately forecast demand, assess emissions impacts, and design policies that protect ratepayers while supporting decarbonization.

Policy Precedent

Requiring data disclosures from DCs is not a novel regulatory concept. NYS can look to already pre-existing disclosure frameworks to inform the metrics and timelines that they require DCs to report on. Across the U.S., at least 10 states have introduced legislation requiring regular reporting of energy and water use, reflecting a broader policy trend toward improving data availability for grid planning and regulatory oversight (NCEL, 2025). California Assembly Bill 1577 (AB 1577), introduced in 2026, establishes requirements for standardized, facility-level reporting of DC energy and resource use. The bill is designed to improve transparency and enable more effective grid planning and emissions tracking.

POLICY PRECEDENT — CALIFORNIA AB 1577

Key Provisions

- DCs must report operational data on a regular (monthly or annual) basis to the California Energy Commission
- Required disclosures include: total energy consumption, peak electricity demand, power usage effectiveness (PUE), water use, backup generator fuel use and runtime, and share of carbon-free or renewable electricity
- Reported data is aggregated to provide system-level visibility, and is reported on publicly each year
- Data is intended to inform regulators and grid operators on load growth, peak demand impacts, and emissions trends

AB 1577 reflects a broader trend toward improving data availability for large electricity users, particularly as DCs become a major driver of load growth. This model demonstrates how standardized reporting can support evidence-based policy design and grid planning. A similar framework could be applied to DCs in NYS with NYSERDA acting in a similar capacity to the California Energy Commission in data collection and reporting.

KEY RECOMMENDATIONS

III.II. Promoting Data Transparency

Recommended Actions

NYSERDA's role is to design and pilot reporting frameworks, while formal data collection and enforcement should occur through PSC, NYISO, and DEC processes. NYSERDA should design reporting frameworks for both DCs requesting interconnection and facilities in operations. Below, though not comprehensive of all metrics that could be useful to grid planners, are the metrics that should be reported:

Collection of this information from both DCs in the interconnection queue and DCs in operation will give grid planners and operators as much data as possible to make investment and planning decisions. Inter-agency cooperation will be required to gain insights on best practices and to implement any binding requirements. The roles and responsibilities outlined in the chart below give an overview of what this could look like.

RECOMMENDED REPORTING METRICS

- Peak demand
- Current/expected load profile
- Current/expected ramp rates
- Power quality characteristics
- Peak shaving capabilities
- Load shifting capabilities
- Backup generation fuel type
- Current/expected backup generation annual runtimes
- Current/expected power use effectiveness
- Demand response participation

Expected System Outcomes

With all of the outlined information on-hand from the reported-on metrics, grid planners will be able to make more informed decisions on infrastructure upgrades and grid operators will be better able to ensure grid stability. For NYSERDA, this data can unlock insights into where the biggest needs and gaps are on the grid and allow for appropriate allocation of resources to create incentives for behaviors and technologies that can help overcome these challenges.

Table 5: Proposed Framework for Reporting Functions

Function	NYSERDA	PSC/NYISO	DEC
Define reporting metrics	**Lead**	Support	Support
Require reporting	-	**Lead**	**Lead** (for emission/permitting)
Data collection and analysis	Support (with anlysis strategies)	**Lead**	**Lead** (for emissions data)

KEY RECOMMENDATIONS

III.III. Catalyzing Energy Efficiency Improvements through Liquid Cooling

The second recommendation is to catalyze the deployment of more energy efficient technologies in DCs through the adoption of liquid cooling technologies in favor of CRAC systems. This provides an approach for the next most foundational challenge that DCs pose, which is to reduce total load demanded by DC facilities. Specifically, a focus should be placed on the utilization of liquid cooling technologies in DCs, as these technologies represent the largest source of DC energy use which is readily addressable. Cooling systems account for approximately 30–40 percent of total consumption (Gheni et al., 2026).

Additionally, these systems have the ability to operate in close-loop systems. These systems do not require the introduction of any new water once operational, resulting in major decreases in DC water use.

As a result, improving cooling efficiency is the most immediate and impactful pathway for reducing total power demand as well as total water demand from DCs and the resulting emissions and environmental impacts. Liquid cooling, especially when paired with dynamic control, offers a step change in efficiency relative to traditional air-based systems. These systems can reduce cooling-related energy use by up to 25 percent, with additional reductions of approximately 15 percent achievable through optimized control of coolant flow and temperature (Gheni et al., 2026).

Technology Precedent

Microsoft began deploying liquid cooling systems, including direct-to-chip approaches, in its next-generation DCs to support high-density AI workloads developed in partnership with OpenAI (Microsoft, 2024).

Microsoft chose to deploy direct-to-chip systems to improve the efficiency of heat removal compared to traditional CRAC system. In doing so, it has enabled significantly higher chip densities while reducing water usage and increasing PUE.

CASE STUDY — MICROSOFT'S LIQUID COOLING DEPLOYMENT FOR AI DATA CENTERS

Key Results

- Coolant is circulated in a closed-loop system, resulting in zero water consumption
- Projected to majorly increase water use effectiveness (WUE)
- For Microsoft, this technology negates the need for 125 million liters of water per year per DC
- Increased PUE and chip density

Recommended Actions

Within NYSERDA’s authority, the agency should provide targeted incentives for high-efficiency cooling upgrades, including liquid cooling and dynamic thermal control systems. This is consistent with NYSERDA’s role in supporting technologies that reduce electricity consumption and have market viability in real-world applications.

NYSERDA could also develop and publish technical guidance for high-efficiency cooling in large-load facilities, helping to build market knowledge around best practices and identify technologies that are proven, commercially relevant, and suitable for broader adoption. Where appropriate, this guidance could also support pilot and demonstration efforts for promising technologies that are still emerging but have already been tested outside the lab.

Broader deployment would still require coordination with utilities. Utilities would need to align energy efficiency programs and rate structures with high-efficiency cooling adoption so that developers have a clear and consistent incentive to adopt these technologies.

KEY RECOMMENDATIONS

III.III. Catalyzing Energy Efficiency Improvements through Liquid Cooling

Expected System Outcomes

Adoption of liquid cooling technologies in place of traditional CRAC systems (referred to as “mechanical cooling in the figure below) represents the most immediate opportunity to meaningfully reduce the energy intensity of DCs. By improving the efficiency of cooling systems, overall facility electricity demand is reduced across all operating conditions, including peak periods when grid constraints and emissions are highest. This leads to lower total load growth from new DC development and reduces the need for costly generation and transmission upgrades.

Additionally, these systems have the potential for large reductions in the water usage of DCs compared to CRAC or non-closed loop evaporative (referred to as “adiabatic” in the figure below) cooling systems. While this was out of the scope of this project, water-use reduction through liquid cooling technologies addresses an additional environmental risk.

At the system level, more efficient cooling reduces strain on the grid and helps limit increases in marginal emissions associated with additional electricity demand. For NYSERDA, accelerating the adoption of these technologies supports broader decarbonization goals while ensuring that DC growth is managed in a way that minimizes impacts on ratepayers and system reliability.

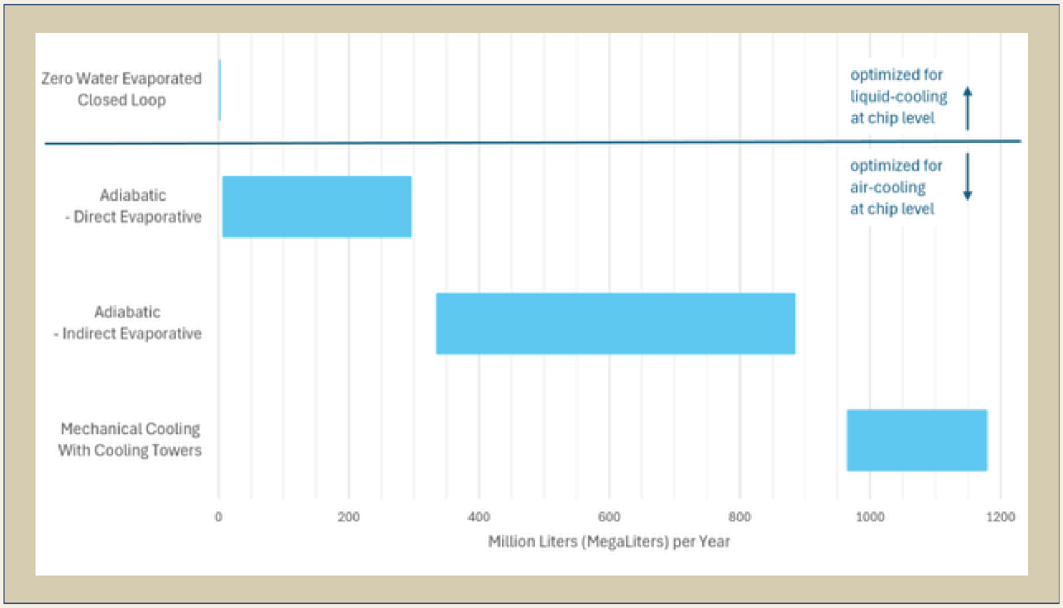

Figure 10 (left): Water usage of various cooling technologies in DCs (Source: Microsoft)

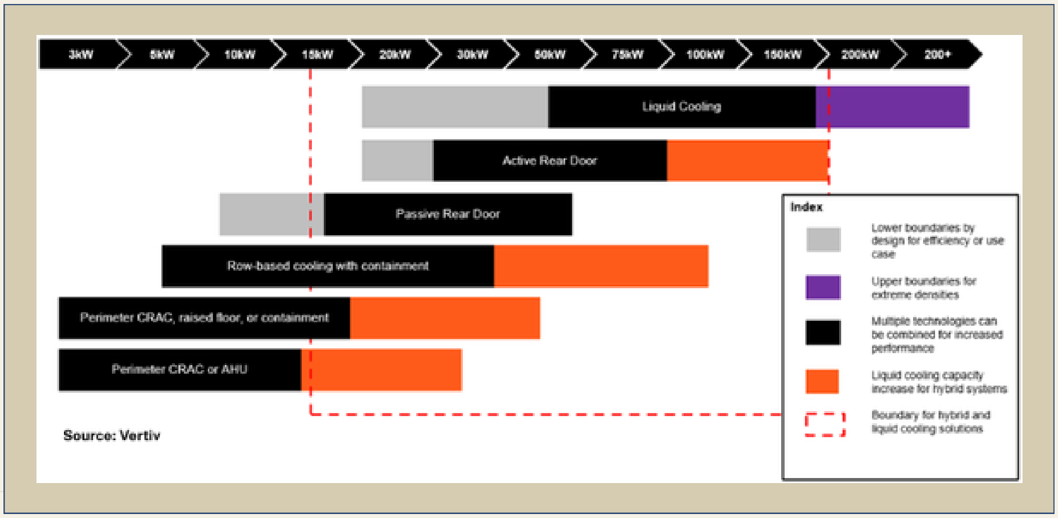

Figure 11 (right): Rack power densities achievable with various cooling technologies

KEY RECOMMENDATIONS

III.IV. Facilitating Demand Flexibility

As DC demand scales, emissions impacts will increasingly depend on when electricity is consumed, particularly during peak periods when marginal generation is often fossil-based. Through optimization of workload timing and location, reliable load reduction and temporal shifting can reduce operational emissions by up to approximately 25 percent (Stanton, n.d.). Enabling DCs to operate as flexible, grid-responsive loads is critical to reducing system-wide emissions. DCs are uniquely positioned to provide load flexibility through shifting or deferring of non-critical computing tasks, utilization of on-site capacity for peak shaving, and participation in demand response programs to reduce their marginal demand contribution in times of the greatest power demand on the system.

Policy Precedent: Texas Senate Bill 6 (SB 6)

In response to rapid load growth, Texas enacted Senate Bill 6 (2025), establishing a framework to ensure that large loads contribute to system reliability. Based on projections provided by ERCOT that total demand could rise from 87 GW in 2025 to 138 GW by 2030, SB 6 introduced both mandatory and market-based demand response mechanisms.

Mandatory response mechanisms require large-load customers above 75 MW to participate in emergency curtailment programs, including reducing load or deploying on-site backup generation. They are to install control or shutoff equipment as a condition of interconnection.

In parallel, voluntary demand response programs allow large-load customers to receive compensation for reducing consumption during peak periods, enabling demand-side resources to compete directly with supply-side solutions (Martucci, 2025; McGuireWoods, 2025).

POLICY PRECEDENT — TEXAS SB 6

Key Provisions

- ERCOT is required to study the reliability impacts of adding large, concentrated loads to the grid, particularly in constrained regions
- Large loads may be required or encouraged to demonstrate the ability to reduce or adjust demand during grid stress events
- Load flexibility is treated as a potential reliability resource, rather than assuming large loads operate as fixed demand
- The legislation enables greater scrutiny of how large loads contribute to peak demand and system risk

While SB 6 does not mandate a single uniform standard for dispatchability, it establishes a framework in which large electricity users are expected to participate in maintaining grid reliability, including through demand reduction or operational flexibility (ERCOT, 2026).

This approach signals a shift in how large loads are treated by grid operators. Rather than being passive consumers, DCs are increasingly expected to actively manage demand in response to system conditions. Similar mechanisms could be employed in NYS to ensure that load growth from DCs is managed in such a way to minimize impacts on grid stability, ratepayers, and emissions of the NYISO grid..

KEY RECOMMENDATIONS

III.IV. Facilitating Demand Flexibility

Recommended Actions

Within NYSERDA's Authority

Target incentives toward measurable demand flexibility capabilities: Prioritize funding for DC projects that can demonstrate verifiable peak load reduction or temporal load shifting.

Condition program eligibility on demand flexibility integration: Require new DC projects receiving NYSERDA support to incorporate baseline flexible load capabilities.

Fund high-impact demonstration projects: Focus pilot funding on high-leverage, state-of-the-art deployments that test real-time load coordination with grid operators, including AI-enabled workload shifting across regions and participation in wholesale market signals.

Requires Coordination with the PSC, NYISO, and/or Utilities

Include minimum requirements into interconnection processes: Evaluate whether large-load DC interconnection approvals should be contingent on demonstrating a defined level of dispatchable or interruptible load capability, particularly in constrained zones.

Align tariff structures to compensate flexible load: Expand or modify demand response and ancillary service programs to allow large-load DCs to be compensated for verified flexibility, including participation in capacity and reliability markets where feasible.

Establish clear expectations for large-load DC participation in grid reliability: Develop guidance or regulatory frameworks that define when and how large-load DCs are expected to respond during system stress events, including both voluntary and mandatory mechanisms.

Expected System Outcomes

Implementation of these demand flexibility strategies would enable large DC loads to function as dispatchable, grid-responsive resources rather than fixed demand, resulting in a reduction of peak load growth and limiting reliance on high-emissions marginal generation. This would alleviate stress on constrained portions of the transmission and distribution system, defer or avoid costly infrastructure upgrades, and improve overall system reliability during periods of grid stress. By aligning load with periods of lower system demand and higher renewable generation, these strategies would also support more efficient integration of renewable energy resources within the NYISO service area while mitigating upward pressure on rates and enhancing long-term system planning outcomes for both utilities and regulators.

Conclusion

The magnitude of grid impacts and the effects on ratepayers and emissions due to data center interconnection in NYS remains uncertain. However, there are clear, actionable strategies for NYSERDA to mitigate the associated risks.

Large-load DC interconnection and operations are an emerging priority at both the federal and New York State levels, and the regulatory landscape governing these developments is evolving rapidly. At the same time, there is significant uncertainty surrounding both short- and long-term load growth in the NYISO service area as new data centers seek to interconnect.

Our research in this report focuses on actionable, near-term strategies designed to deliver meaningful system-level impacts. While not exhaustive, the research and recommendations highlight key approaches that NYSERDA could pursue or support to mitigate grid stress, limit ratepayer cost risk, and reduce emissions associated with large-load DC growth in New York State.

Going forward, large-load DC development will be shaped by technology and operational efficiencies, supported by coordinated policy frameworks and stakeholder engagement, enabling New York State to guide growth in a way that minimizes grid impacts and supports its long-term clean energy goals.

Image 3: Rural Data Center (Source: Geoffrey Moffett / Unsplash)

ADDITIONAL MATERIALS

Appendix A - Sources of Power Generation

Sources of Power Generation in NYS

New York State’s power generation fleet is highly diverse, with capacities distributed across natural gas, hydro, nuclear, wind, solar, and a small remaining presence of crude-fired units and legacy coal. Natural gas dominates installed capacity in and around major load centers such as New York City (Queens, Kings, Bronx, New York, Nassau, Suffolk, and Rockland), where large gas-fired plants provide the bulk of generation.

Upstate counties host most of the state’s renewable and zero-carbon capacity: Niagara, Saratoga, Jefferson, Oneida, St. Lawrence, and others feature substantial hydro resources, while Lewis, Franklin, Wyoming, Clinton, and Steuben have significant wind installations; solar is more broadly distributed at smaller scales, appearing in many counties as modest but widespread capacity addition. Nuclear power is concentrated in a very limited number of locations (notably Oswego and Wayne counties), where single large stations contribute substantial base load zero-emission capacity despite being few in number.

Overall, the pattern shows downstate reliance on gas-fired generation balanced by upstate hydro, wind, solar, and nuclear assets. These differences underscore both the regional interdependence of the state's grid and the growing role of renewables alongside conventional thermal plants. Figure 5 and Table 2 show the spatial and capacity distribution of State’s Power Systems.

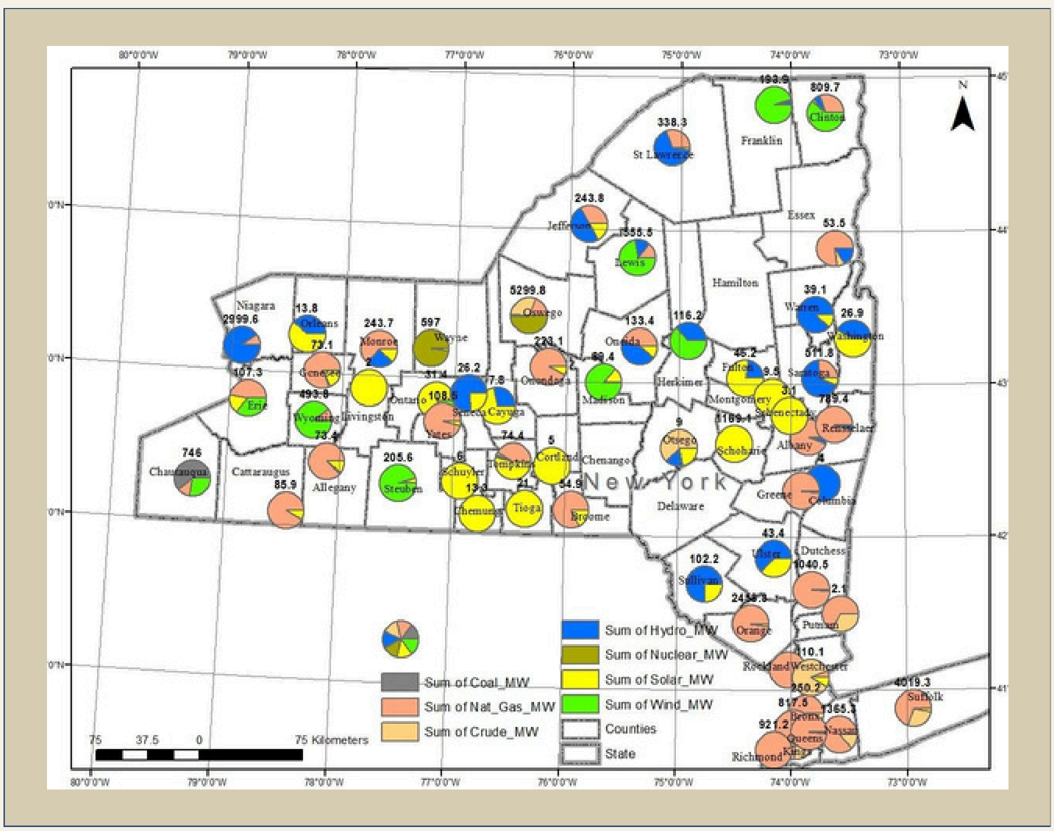

Figure 11: County-wise and source-wise distribution of Power Generation for New York State (prepared using ArcGIS 10.4)

ADDITIONAL MATERIALS

Appendix B - Queued Data Center Projects vs. NYISO Gold Book

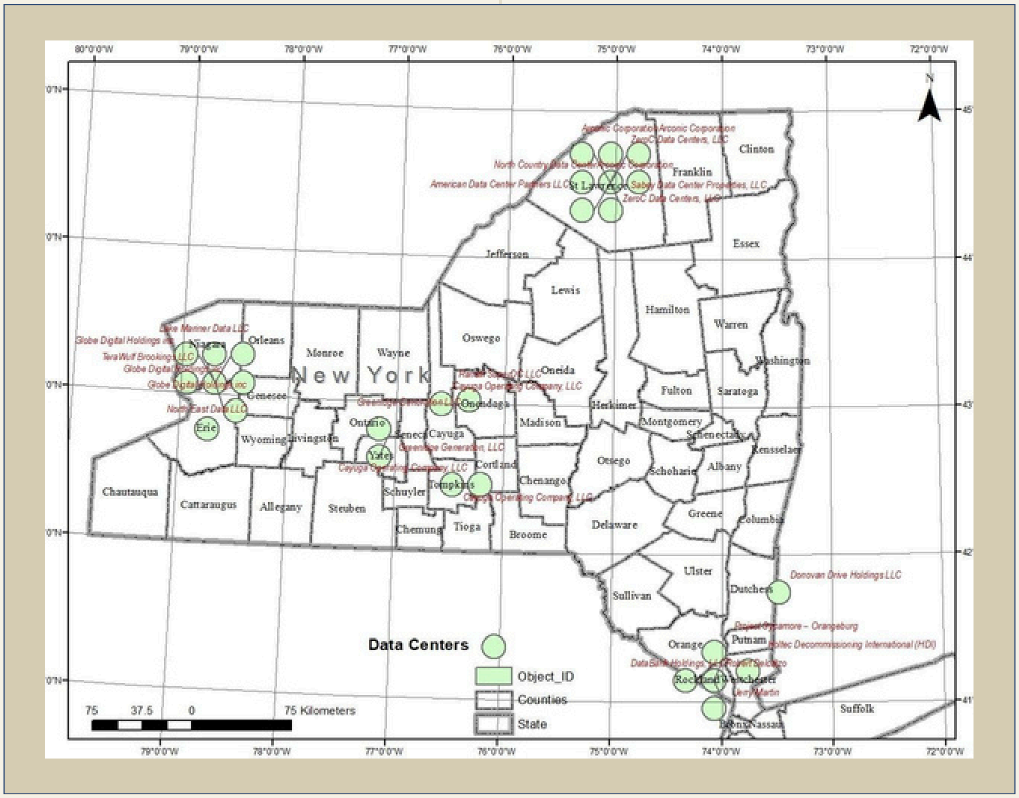

Figure 12: County-wise distribution of Data Centers in NYISO Queuing List (prepared using ArcGIS 10.4)

Data Center Developers in NYS

A number of well-known energy and infrastructure players, such as American Data Center Partners, Arconic, Cayuga Operating Company, Globe Digital Holdings, Greenidge Generation, Lake Mariner Data, Niagara Falls Redevelopment, Sabey Data Center Properties, TeraWulf, and ZeroC Data Centers are leading these proposals, often planning multi-phase campuses (e.g., 200–300 MW blocks) rather than single small facilities.

Many projects also identify specific transmission owners such as National Grid, NYPA, NYSEG, Central Hudson, and NM-NG, highlighting that these data centers are tightly linked to the high-voltage grid. On average, each project’s load is on the order of tens to hundreds of megawatts, with annual energy consumption per site commonly in the range of roughly 0.2 to over 3 TWh, pointing to a major upcoming impact on regional electricity demand.

NYISO Queue vs. Gold Book

Current large load interconnection queue requests (as of February 19, 2026) stand at 11.8 GW (NYISO, 2026), a figure that stands in stark contrast to the New York State 2025 Gold Book's large load forecast, which projects a maximum summer peak electricity demand attributable to large loads of only 2.1 GW by 2035 (NYISO Gold Book, 2025, Table I-14).

The Gold Book projection incorporates the anticipated impacts from energy efficiency programs and building codes, distributed energy resource penetration, and the retirement of aging facilities. However, the discrepancy is still extremely large, highlighting the huge amount of uncertaintiy as to the realization rates of projects that enter the interconncection queue.

ADDITIONAL MATERIALS

Appendix C - Case Study: Oracle Data Center

Analyzed here are case studies of existing and proposed large-load data centers and evaluates data center policies in the United States. Data centers were analyzed according to their management practices, energy demand, environmental impact, and community impact. They are included here for reference as to strategies that have been implemented in other jurisdictions/scenarios to varying degrees of success.

Oracle DC: Port Washington, WI

Oracle is a technology company founded in 1977 that specializes in database software, cloud-engineering, and enterprise software. The company has heavily integrated AI into its technology offerings. In August 2025, Vantage Data Centers, Open AI, and Oracle proposed the development of a $15 billion campus in Port Washington, WI, an hour north of Milwaukee. The total electrical capacity of the project is expected to be 1.3 GW, used between the three organizations (Halbig, 2025). Oracle is known for their closed-loop cooling of AI data centers, which are planned for use in the Wisconsin facility. Their cooling systems are direct-to-chip, closed-loop, and non-evaporative (Grizzel, 2026).

In addition to cooling technology, Oracle states that 70% of energy for the campus will come from zero-emission sources, including wind, solar, and battery energy storage systems. The project will add 2,000 MW of new zero-emission power to Wisconsin's grid. It will fund all electrical infrastructure upgrades, requiring no increase to local energy bills. Oracle also claims the project will create 4,000 union construction jobs and 1,000 onsite jobs. They report a focus on restoring local wetlands, increasing biodiversity (through 100 acres of open space on their 670- acre campus) and minimizing light pollution (Oracle, 2026). The companies involved in center development will also spend $175 million upfront to develop water and sewer main extensions, as well as road improvements. The city will then use a Tax Incremental District (TID) to reimburse these upfront costs.

Despite these stated benefits, there are drawbacks to this plan. The Port Washington Town Council voted in November to create a TID for the campus (Casey, 2025). This means the local government will divert property tax revenue raised from the district's growth to finance development infrastructure (Schulz, 2026). In January, community members filed a lawsuit against the city, stating the TID provides more public subsidy to the project than is needed: property tax reimbursements and interest payments to the developer will total more than $458 million over the next 18 years (Schulz, 2026). They also claim there is not enough evidence this project will improve property values in the region to justify a TID. The center faces extreme community pushback from the organization "Save Port Washington" that was founded to fight development. Oracle's website lists promises concerning energy usage, job creation and regional development, but few details on how they will accomplish these goals or metrics that will be used to measure success.

Image 4: Oracle Port Washington Facility Rendering. DCD.

ADDITIONAL MATERIALS

Appendix D - Case Study: TeraWulf Data Centers

TeraWulf's DCs: Lake Mariner and Cayuga, New York

TeraWulf is a digital-infrastructure company that develops and operates facilities for Bitcoin mining and high-performance computing, such as AI-based tasks. It operates the Lake Mariner campus on Lake Erie and is currently developing a large new campus in Lansing on Cayuga Lake, developing both as hyperscale-level, "predominately zero-carbon" data centers (TeraWulf, 2024). Together, the two sites could approach 900 MW of demand, making them among the largest data centers in New York State (DataCenterMap, n.d.). The Cayuga project is part of TeraWulf's recent move to expand its AI-oriented infrastructure by signing a $3.7 billion hosting agreement with Fluidstack, primarily backed by Google (TeraWulf, 2024).

TeraWulf promises to deliver low-carbon emissions from their developments and minimize impacts on both local residents and the environment. The two sites lay in abandoned coal-based power plants, repurposing old infrastructure for modern issues. Both sites also utilize closed-loop cooling systems to minimize water usage, and TeraWulf claims to have 91% zero-carbon energy sources thanks to nearby hydropower projects (European Environment Agency, n.d.; Inside Climate News, 2025).

Some unions and local businesses support the development for its job and tax-base potential, but both sites have faced numerous complaints and challenges from locals and municipalities. Tensions escalated when Cayuga Operating Company LLC, who owns the site property, reportedly threatened lawsuits against residents who spoke against the project at public meetings, further politicizing the project's approval process (Massaro, 2025). Residents primarily noted historic issues with the Lake Mariner site, such as noise from operating equipment, risks to drinking water water supply from contamination, and rising energy costs. The complaints resulted in a moratorium on all data centers in Lansing, which was eventually withdrawn in November of 2025 after months of public debate (Town of Lansing, 2025).

The Cayuga project raises a variety of accountability concerns. The Cayuga's facility's electricity consumption could be equivalent to about 16 percent of the Robert Moses Niagara Hydroelectric Power Station's output (Sherry, 2025). While this arrangement allows TeraWulf to claim that the project is "zero-carbon," it does not account for the increase in demand on the grid that will eventually have to be met through new generation.

Additionally, TeraWulf currently holds water withdrawal rights under Cayuga Operating Company LLC; while this permit dates back decades and was never intended for use in data center operation, TeraWulf has sought to maintain this permit from the DEC at the same time as it promises to not use said water in its operations.

If TeraWulf were to eventually draw upon this water, it's unclear if the municipality has the tools to enforce their agreement as long as this state-approved permit stands. Lake Mariner and the planned Cayuga Lake facility illustrate the risk of greenwashing and low accountability in the state's current regulation.

Image 5: TeraWulf Lansing Facility Rendering. The Cornell Daily.

ADDITIONAL MATERIALS

Appendix E - Case Study: Micron Semiconductor Facility

Micron Manufacturing Facility: Town of Clay, NY

Micron Technology, Inc. is a semiconductor manufacturer specializing in memory and storage technologies used in data centers and advanced computing. In October 2022, Micron announced plans to invest up to $100 billion over more than 20 years to construct manufacturing facilities in Onondaga County near Syracuse, New York, with an anticipated total load approaching 1,000 MW (Micron Technology, 2026). In January 2026, the company officially broke ground on Phase 1 of the project (Micron Technology, 2026). Micron reports measurable progress on environmental goals, including reductions in greenhouse gas emissions, water reuse and recycling, and commitments to 100% renewable electricity and sustainable building practices such as LEED Gold design standards at its facilities worldwide (“Sustainability Report”, 2024).

According to Micron’s New York expansion fact sheet, the project is expected to create approximately 9,000 direct Micron jobs and more than 40,000 additional construction and supply-chain jobs, totaling nearly 50,000 jobs statewide over the life of the project (Micron Technology, 2026; State of New York, 2025). New York State has characterized it as one of the largest private-sector investments in state history. The initiative is supported by substantial public incentives: Micron may receive up to $5.5 billion in performance-based Excelsior Jobs Program tax credits, contingent on meeting job creation and capital investment benchmarks (Empire State Development, 2026). The project is also tied to the state’s Green CHIPS legislation, which links incentives to environmental and sustainability standards (Empire State Development, 2024). In parallel, New York established a $500 million Green CHIPS Community Investment Fund to support workforce development, housing, and regional infrastructure.

The scale of the project requires significant infrastructure upgrades. In October 2025, state regulators approved a two-mile, 345-kilovolt underground transmission line to connect an existing substation to the Micron site, addressing projected electrical demand (State of New York, 2025; Reuters, 2025). Water demand across all fabs could reach approximately 48 million gallons per day, though Micron has pledged high levels of water recycling and conservation (WSKG, 2023). In December 2025, the New York State Department of Environmental Conservation issued permits including conditions related to freshwater protection, wetlands mitigation, stormwater management, and environmental monitoring (NYSDEC, 2025).

Despite these commitments, public perception in Central New York is mixed. State leaders emphasize long-term economic revitalization and supply-chain growth, while local opinions highlight concerns about environmental impacts, infrastructure strain, and the scale of public subsidies (State of New York, 2025; WAER, 2025; Empire Center for Public Policy, 2025). While the project promises substantial economic benefits, its intensive electricity and water demands make environmental performance and regulatory enforcement critical. Careful and robust oversight is essential to maintaining public trust and ensuring that the development aligns with New York State’s climate and sustainability goals.


Image 6: Micron Clay Facility Rendering. Syracuse.com.

ADDITIONAL MATERIALS

Appendix F - Economic Analysis of Data Center Regulations

Principle Economic Costs

Rapid growth in large-load data center electricity demand is creating both opportunities and challenges for power systems. Data-centers are highly capital-intensive, with construction costs averaging about $12 million per MW, alongside close to $1 million per MW per year required for technology upgrades (Vila, 2025; Cohen & Russo, 2025). Operating costs are dominated by electricity consumption. Research shows that delaying a project by one year requires about a 25 percent reduction in electricity costs to offset the lost value of computing capacity (Cohen & Russo, 2025). As a result, hyperscalers prefer speed-to-market. However, this can create adverse system impacts, such as upgrades to the electricity grid and environmental degradation from electricity and water consumption. This underscores the need for state policies and regulatory frameworks that ensure fair cost allocation, maintain affordability, and address externalities (Noffsinger et al., 2025; EPRI, 2024). While NYSERDA may not have direct authority to propose, ratify, or implement state policy, it is a key player and thought leader in New York State's energy sector and a valuable advocate for appropriate legislation.

Economic Instruments

- **Incentives**: These are mainly of two types: a) technology incentives that support research and development and b) demand-side incentives that enable large loads to shift consumption across time.
- **Subsidies and Tariffs**: These include pricing mechanisms that ensure cost causation, and limit upward pressure on electricity rates for existing customers.
- **Cost-recovery and Allocations**: These are regulatory mechanisms that allow for long-term contracts, minimum billing requirements, and exit fees, thereby ensuring revenue adequacy for utilities, and assigning costs to the customers driving demand.

Case Studies

Incremental Cost Recovery: Georgia PSC (2025–2026)

Key Provisions

- Customers above 100 MW are required to bear the full incremental cost of generation, transmission, and distribution infrastructure
- Long-term contracts (up to 15 years, extended from earlier 5-year terms), minimum billing provisions, and exit fee obligations
- "No cost shifting" principle, supported by a rate freeze through 2028 (Georgia PSC, 2025)
- Utilities are required to engage with customers on demand-side flexibility options
- Creditworthy demand provides investment certainty supporting renewables deployment

Long-term Infrastructure Partnerships: Louisiana (2025)

Key Provisions

- Agreement between Entergy and Meta where Entergy builds dedicated generation capacity
- Meta provides financial guarantees through a 15-year revenue commitment and funds key infrastructure such as substations
- This model avoids cost-shifting to existing ratepayers through improved utilization

Incentivising Technology Adoption: Waste Heat Reuse in Denmark (2022)

Key Provisions

- Abolished its surplus heat tax in 2022
- Enabled a large facility in Odense to export ~215,000 MWh/year to local households (David Gardiner & Associates, 2025; Gardiner, 2024)
- Presence of legacy district heating infrastructure kept incremental integration costs well below existing system averages

ADDITIONAL MATERIALS

References

1. Bloom Energy. (n.d.). The AI revolution: How fuel cells are solving the data center power challenge. https://www.bloomenergy.com/blog/the-ai-revolution-how-fuel-cells-are-solving-the-data-center-power-challenge/
2. Boesten, S., Ivens, W., Dekker, S. C., & Eijdems, H. (2019). 5th generation district heating and cooling systems as a solution for renewable urban thermal energy supply. Advances in Geosciences, 49, 129-136. https://doi.org/10.5194/adgeo-49-129-2019
3. Boydcorp. (n.d.). Energy consumption in data centers: Air versus liquid cooling. https://www.boydcorp.com/blog/energy-consumption-in-data-centers-air-versus-liquid-cooling.html
4. Brancucci, C., Cutler, D., Elgqvist, E., Jenkins, J., Case, N., Burger, S., Brisley, S., Kenyon, W., Frazier, W., & Ricks, W. (2025, December). Flexible data centers: A faster, more affordable path to power. Camus, encoord, and Princeton ZERO Lab. https://cdn.prod.website-files.com/60dbdcca2e4b1919e8894fa5/6930abf1be0f36db6fc27157_Whitepaper%20-%20With%20Appendix.pdf
5. Buffa, S., Cozzini, M., D'Antoni, M., Baratieri, M., & Fedrizzi, R. (2019). 5th generation district heating and cooling systems: A review of existing cases in Europe. Renewable and Sustainable Energy Reviews, 104, 504–522. https://doi.org/10.1016/j.rser.2018.12.059
6. Casey, E. (2025, November 5). Port Washington council approves TID for $15B data center campus as residents continue to speak out. Wisconsin Public Radio. https://www.wpr.org/news/port-washington-council-approves-tid
7. Cohen, M., & Russo, C. (2025, September 12). EFLOPS >> MWs: The economics behind data center growth. Charles River Associates. https://www.crai.com/insights-events/publications/eflops-mws-the-economics-behind-data-center-growth
8. Crosley, B. (2026, January 4). FERC’s data center colocation ruling: Complete guide. Introl. https://introl.com/blog/ferc-pjm-colocation-ruling-data-center-power-plant-guide-2025
9. Dalban, L. (2025, November 18). A data center could be coming to an upstate New York town, and residents are speaking out. Inside Climate News. https://insideclimatenews.org/news/08112025/lansing-new-york-data-center-development/?gad_source=1&gad_campaignid=22688141957&gbraid=0AAAADogIi2vrtMmdZabJXiWdpH6Z76Fz&gclid=CjwKCAiAncvMBhBEEiwA9GU_fiXySQzgeyFm_yh8s5wIdSBPQmMHGCcPrWo0G3TFmleSZEF-7NXasBoCCdIQAvD_BwE
10. Data Center Dynamics. (2025, May 6). Microsoft study finds liquid cooling can cut data center emissions by up to 21%. https://www.datacenterdynamics.com/en/news/microsoft-study-finds-liquid-cooling-can-cut-data-center-emissions-by-up-to-21/
11. DataCenterMap. (n.d.). Lake Mariner Data – Buffalo, New York. DataCenterMap. https://www.datacentermap.com/usa/new-york/buffalo/lake-mariner-data/
12. David Gardiner & Associates. (2025, September 18). Data center heat reuse: The opportunity for states. https://www.dgardiner.com/data-center-heat-reuse-the-opportunity-for-states/
13. Electric Power Research Institute (EPRI). (2024). Powering intelligence: Load growth. https://powering-intelligence.epri.com/load-growth.html
14. Electric Reliability Council of Texas (ERCOT). (2026). 89th Legislative Session – ERCOT status update. https://www.ercot.com/files/docs/2025/09/15/89th-Legislative-Session-PPTX-ERCOT-Status-March-2026-Final-Website.pdf

ADDITIONAL MATERIALS

References

15. Empire Center for Public Policy. (2025, February 23). How NY businesses get shafted - as Albany boosts Idaho's Micron with $5.5B. https://www.empirecenter.org/publications/how-ny-businesses-get-shafted-as-albany-boosts-idahos-micron-with-5-5b/
16. Empire State Development. (2024). Green CHIPS Community Investment Fund. https://esd.ny.gov/green-chips-community-investment-fund
17. Empire State Development. (2026). Micron in Central New York. https://esd.ny.gov/micron
18. European Environment Agency. (n.d.). Reducing water consumption for cooling of thermal generation plants. Climate-ADAPT. https://climate-adapt.eea.europa.eu/en/metadata/adaptation-options/reducing-water-consumption-for-cooling-of-thermal-generation-plants
19. Gardiner, D. (2024, April 22). Policies to accelerate data center heat reuse: Achieving economic and climate change goals. David Gardiner & Associates. https://www.dgardiner.com/policies-to-accelerate-data-center-heat-reuse-achieving-economic-and-climate-change-goals/
20. Georgia Public Service Commission (PSC). (2025, December 1). 2025 data center fact sheet. https://psc.ga.gov/site/downloads/datacenterfactsheet.pdf
21. Gheni, M., Kerskes, H., & Stergiaropoulos, K. (2026, January). Operational analysis of the cooling system in a direct liquid-cooled data center: A measurement and simulation study on the impact of supply water temperature. Applied Energy, 403, 127061. https://doi.org/10.1016/j.apenergy.2025.127061
22. Gjoka, K., Rismanchi, B., & Crawford, R. H. (2023). Fifth-generation district heating and cooling systems: A review of recent advancements and implementation barriers. Renewable and Sustainable Energy Reviews, 171, 112997. https://doi.org/10.1016/j.rser.2022.112997
23. Governor Hochul Unveils Ratepayer Protection Plan to Hold Energy Companies Accountable and Ensure a Reliable Grid. (2026). Governor Kathy Hochul. https://www.governor.ny.gov/news/governor-hochul-unveils-ratepayer-protection-plan-hold-energy-companies-accountable-and-ensure
24. Grizzel, T. (2026, February 9). Closed-loop cooling in Oracle AI data centers: What it is, how it works, and why it matters for local water supplies. Oracle. https://www.oracle.com/news/announcement/blog/closed-loop-cooling-in-oracle-ai-data-centers-2026-02-09/
25. Halbig Ziehm, K. (2025, October 22). OpenAI, Oracle to run Stargate Port data center. Ozaukee Press. https://www.ozaukeepress.com/content/openai-oracle-run-stargate-port-data-center
26. H.R.5227 - 119th Congress (2025-2026): Unleashing Low-Cost Rural AI Act. Congress.gov. (n.d.-a). https://www.congress.gov/bill/119th-congress/house-bill/5227
27. H.R.6529 - 119th Congress (2025-2026): Protecting families from Ai Data Center Energy Costs Act. Congress.gov. (n.d.-a). https://www.congress.gov/bill/119th-congress/house-bill/6529
28. H.R.6984 - 119th Congress (2025-2026): Data Center Transparency Act. Congress.gov. (n.d.). https://www.congress.gov/bill/119th-congress/house-bill/6984/text/ih?format=txt
29. Humes, S. J., McKnight, A. M., & Jacobs, A. (2026, January 27). The emerging regulatory framework to power data centers. Pillsbury Law. https://www.pillsburylaw.com/en/news-and-insights/ferc-regulation-data-centers.html
30. Inside Climate News. (2025, November 17). A data center could be coming to an upstate New York town, and residents are worried. Inside Climate News. https://insideclimatenews.org/news/08112025/lansing-new-york-data-center-development

ADDITIONAL MATERIALS

References

31. Interstate Renewable Energy Council. (2021, July 26). Sharing the Burden and the Benefits: The Quandary of Allocating DER Interconnection Costs. https://irecusa.org/blog/regulatory-engagement/sharing-the-burden-and-the-benefits-the-quandary-of-allocating-der-interconnection-costs
32. Kishore, P. V., & Reddy, S. R. (2014). Power quality improvement using multiple STATCOMs. The International Journal of Engineering and Science. https://theijes.com/papers/ICIEEE/M01010108.pdf
33. Koningstein, R. (2021, May 18). We now do more computing where there's cleaner energy. Google. https://blog.google/company-news/outreach-and-initiatives/sustainability/carbon-aware-computing-location/
34. Lawrence Berkeley National Laboratory. (2023, April 26). SPP data show rising network upgrade costs, especially for withdrawn projects. Electricity Markets & Policy Department. https://emp.lbl.gov/news/spp-data-show-rising-network-upgrade
35. Marshall, A. (n.d.). The new reality of hybrid microgrid controls for data centers. Clarke Energy. https://www.clarke-energy.com/2026/the-new-reality-of-hybrid-microgrid-controls-for-data-centers/
36. Martucci, B. (2025, June 25). Texas law gives grid operator power to disconnect data centers during crisis. Utility Dive. https://www.utilitydive.com/news/texas-law-gives-grid-operator-power-to-disconnect-data-centers-during-crisi/751587
37. McGuireWoods (2025). Texas Senate Bill 6 Significantly Expands Regulatory Oversight Over Large Loads in ERCOT. https://www.mcguirewoods.com/client-resources/alerts/2025/7/texas-senate-bill-6-significantly-expands-regulatory-oversight-over-large-loads-in-ercot/
38. Microsoft. (2024). Sustainable by design: Next-generation datacenters consume zero water for cooling.https://www.microsoft.com/en-us/microsoft-cloud/blog/2024/12/09/sustainable-by-design-next-generation-datacenters-consume-zero-water-for-cooling/
39. Micron Technology, Inc. (2026, January 7). Micron announces groundbreaking for historic New York megafab. https://investors.micron.com/news-releases/news-release-details/micron-announces-groundbreaking-historic-new-york-megafab
40. Micron Technology, Inc. (2026). New York expansion fact sheet. https://www.micron.com/us-expansion/ny/fact-sheet
41. Mordor Intelligence. (2026). New York data center market: Size, share, and growth trends. https://www.mordorintelligence.com/industry-reports/new-york-data-center-market
42. National Conference of State Legislatures (NCEL). (2025). States act to align data center energy demand with climate goals. https://www.ncelenviro.org/articles/states-act-to-align-data-center-energy-demand-with-climate-goals/
43. National Grid. (2026, March 2). UK-first trial of AI grid technology successfully demonstrates ability for data centres to adjust power needs. https://www.nationalgrid.com/uk-first-trial-ai-grid-technology-successfully-demonstrates-ability-data-centres-adjust-power-needs
44. New York Independent System Operator (NYISO). (2017). NYISO Open Access Transmission Tariff, Attachment S, Section 25.6 – Cost Allocation Methodology for ERIS. New York Independent System Operator. https://nyisoviewer.etariff.biz/ViewerDocLibrary/MasterTariffs/9TariffSections/342.htm
45. New York Independent System Operator (NYISO). (2022). Load interconnection procedure and applicability. https://nyiso.my.site.com/MemberCommunity/s/article/Load-Interconnection-Procedure-and-Applicability
46. New York Independent System Operator (NYISO). (2025). 2025 load & capacity data report (Gold Book) [PDF]. https://www.nyiso.com/documents/20142/2226333/2025-Gold-Book-Public.pdf

ADDITIONAL MATERIALS

References

47. New York Independent System Operator (NYISO). (2026). New York Independent System Operator. Interconnection queue. Retrieved Feb 05, 2026, https://www.nyiso.com/interconnections
48. New York State Department of Environmental Conservation (NYSDEC). (2025). DEC issues environmental permits to Micron semiconductor manufacturing project in Onondaga County. https://dec.ny.gov/news/press-releases/2025/12/dec-issues-nine-environmental-permits-to-micron-new-york-semiconductor-manufacturing-project-in-onondaga-county
49. The New York State Senate. (2025). NY State Senate Bill 2025-S9144. NYSenate.gov. https://www.nysenate.gov/legislation/bills/2025/S9144
50. Noffsinger, J., Patel, M., Sachdeva, P., Bhan, A., Chang, H., & Goodpaster, M. (2025, April 28). The cost of compute: A $7 trillion race to scale data centers. McKinsey & Company. https://www.mckinsey.com/industries/technology-media-and-telecommunications/our-insights/the-cost-of-compute-a-7-trillion-dollar-race-to-scale-data-centers
51. Oracle. (2026). Port Washington, Wisconsin Data Center. Oracle. https://www.oracle.com/data-centers/port-washington/
52. Orleans Hub. (2025, December). Allies of Tonawanda Seneca Nation strongly oppose "monstrous data center" proposed for Stamp. Orleans Hub. https://orleanshub.com/allies-of-tonawanda-seneca-nation-strongly-oppose-monstrous-data-center-proposed-for-stamp/
53. Rathnayake, D. B., Akrami, M., Phurailatpam, C., Me, S. P., Hadavi, S., Jayasinghe, G., Zabihi, S., & Bahrani, B. (2021). Grid forming inverter modeling, control, and applications. IEEE Access, 9, 114781–114807. https://doi.org/10.1109/access.2021.3104617
54. Reuters. (2025, October 17). New York approves power line for Micron's $100 billion semiconductor plant. https://www.reuters.com/sustainability/boards-policy-regulation/new-york-approves-power-line-microns-100-billion-semiconductor-plant-2025-10-16/
55. Ross, M., & Ewing, J. (2026, February 17). Data centers and generation capacity over the next decade: Potential benefits of flexibility. Nicholas Institute for Energy, Environment & Sustainability, Duke University. https://nicholasinstitute.duke.edu/publications/data-centers-and-generation-capacity-over-next-decade
56. S.3682 - 119th Congress (2025-2026): Power for the people act of 2026. Congress.gov. (n.d.-a). https://www.congress.gov/bill/119th-congress/senate-bill/3682
57. Schulz, J. (2026, February 13). Community group challenges Port Washington's data center TID in court. Wisconsin Public Radio. https://www.wpr.org/news/community-challenges-port-washingtons-data-center-tid-court
58. Sherry, A. (2025, December). TeraWulf AI data center set to proceed construction without yearlong delay. The Ithacan. https://theithacan.org/64667/news/terawulf-ai-data-center-set-to-proceed-construction-without-yearlong-delay/
59. Spieler, M. (2025, July 1). How AI factories can help relieve grid stress. NVIDIA. https://blogs.nvidia.com/blog/ai-factories-flexible-power-use/
60. Stanton, M. (n.d.). Transforming data centers into grid-responsive powerhouses. Boston University Center for Information & Systems Engineering. https://www.bu.edu/cise/transforming-data-centers-into-grid-responsive-powerhouses/

ADDITIONAL MATERIALS

References

61. State of New York (Office of Governor Kathy Hochul). (2025, October 16). Governor Hochul marks progress on Micron's $100 billion investment in New York with approval of critical infrastructure. https://www.governor.ny.gov/news/governor-hochul-marks-progress-microns-100-billion-investment-new-york-approval-critical
62. Sustainability Report (2024). Micron Releases 2024 Sustainability Report Highlighting Progress and Long-Term Vision. https://investors.micron.com/news-releases/news-release-details/micron-releases-2024-sustainability-report-highlighting-progress
63. TeraWulf Inc. (2024). TeraWulf signs 200 MW, 10-year AI hosting agreements with Fluidstack [Press release]. TeraWulf. https://investors.terawulf.com/news-events/press-releases/detail/112/terawulf-signs-200-mw-10-year-ai-hosting-agreements-with
64. Town of Lansing. (2025, November 19). Lansing Town Board Meeting 11/19/25. YouTube. https://www.youtube.com/watch?v=8KKBd3-p7Fg
65. University of California San Diego. (2025, June 13). New cooling tech could curb data centers' rising energy demands. https://today.ucsd.edu/story/new-cooling-tech-could-curb-data-centers-rising-energy-demands
66. Uptime Institute. (2025). Heat reuse: A management primer. https://uptimeinstitute.com/resources/research-and-reports/heat-reuse-a-management-primer
67. U.S. Department of Energy. (2023, May 11). Tackling high costs and long delays for clean energy interconnection. Interconnection Innovation e-Xchange (i2X). https://www.energy.gov/eere/i2x/articles/tackling-high-costs-and-long-delays-clean-energy-interconnection
68. U.S. Department of Energy. (2024, December 20). DOE releases new report evaluating increase in electricity demand from data centers. https://www.energy.gov/articles/doe-releases-new-report-evaluating-increase-electricity-demand-data-centers
69. U.S. Senator Elizabeth Warren. (2026, March 26). Warren, Hawley lead bipartisan push for mandatory energy use reporting requirements for data centers. U.S. Senate. https://www.warren.senate.gov/newsroom/press-releases/warren-hawley-secure-mandatory-energy-use-reporting-requirements-for-data-centers
70. Vila, D. (2025, November 13). Deconstructing the data center: A look at the cost structure igniting the AI boom! Alpha Matica. https://www.alpha-matica.com/post/deconstructing-the-data-center-a-look-at-the-cost-structure-1
71. Von Meier, A. (2006). Electric power systems: A conceptual introduction. Wiley-IEEE Press. https://gacbe.ac.in/images/E%20books/Electric%20Power%20Systems%20-%20A%20Conceptual%20Introduction%20-%20A.%20von%20Meier%20%28Wiley,%202006%29.pdf
72. WAER. (2025, November 10). Onondaga County officials set to consider tax incentive deal for Micron amid community concerns. https://www.waer.org/news/2025-11-10/onondaga-county-officials-set-to-consider-tax-incentive-deal-for-micron-amid-community-concerns
73. White & Case LLP. (2025, October 27). DOE directs FERC to accelerate interconnection of data centers. White & Case LLP. https://www.whitecase.com/insight-alert/doe-directs-ferc-accelerate-interconnection-data-centers
74. Wirtz, M., Kivilip, L., Remmen, P., & Müller, D. (2020). 5th Generation District Heating: A novel design approach based on mathematical optimization. Applied Energy, 260, 114158. https://doi.org/10.1016/j.apenergy.2019.114158

ADDITIONAL MATERIALS

References

75. WSKG. (2023, August 6). Micron estimates needing up to 48 million gallons of water a day, aiming to achieve 100% water conservation. https://www.wskg.org/news/2023-08-06/micron-estimates-needing-up-to-48-million-gallons-of-water-a-day-aiming-to-achieve-100-water-conservation
76. Yan, W., Gevorgian, V., Koralewicz, P., Wallen, R., & Alam, S. M. (2024). Demonstration of power system black start with hydropower generator and battery energy storage. National Renewable Energy Laboratory.
77. Zhang, X., Wu, J., & Fu, Y. (2025, January). Voltage support strength analysis and stability control strategy for grid-forming wind power transmission system. IET Renewable Power Generation. https://doi.org/10.1049/rpg2.13194