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Speed to Power | Flexible Demand | Backup Cooling

Data Center Solutions Brief

Table of Contents

Speed to Power
Flexible Demand
Backup Cooling

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Thermal Energy Storage Addresses Data Center Power Constraints

Cold-thermal energy storage is a safe, reliable and cost-effective solution for increasing IT capacity and expediting grid connection

Summary

Any demand for electricity that a data center can curtail at peak times can be used to increase its computing capacity, or help to expedite grid connection, aka “speed to power”. Due to a shortage of grid capacity, connections for new data centers take years and costs many millions in lost revenues. But there are now opportunities to significantly cut down these waiting times. Utilities and grid operators in major data centers development hubs began offering faster connection for data centers that can lower demands at peak hours (i.e., “flexible large loads”)[1] and the Energy Secretary has guided FERC to issue a formal policy on expediting connections of these flexible loads.[2]

Thermal energy storage is an ideal tool for flexing a data center’s demand for cooling power, which can be up to 40% of its total electric load at peak times. By creating and storing thermal energy during off-peak hours, and then using it at peak to replace grid power, the cooling load is curtailed, with zero impact on computing performance. It can even be done daily to reduce electricity costs, generate revenues in the power market and reduce associated emissions. Unlike lithium-ion batteries, thermal energy storage is completely safe and does not require any special permitting.

[1] See examples like Texas (Senate Bill 6), SPP, Arizona Public Service.

[2] Secretary of Energy decision under Section 403 of the Department of Energy Organization Act (October 23, 2025)

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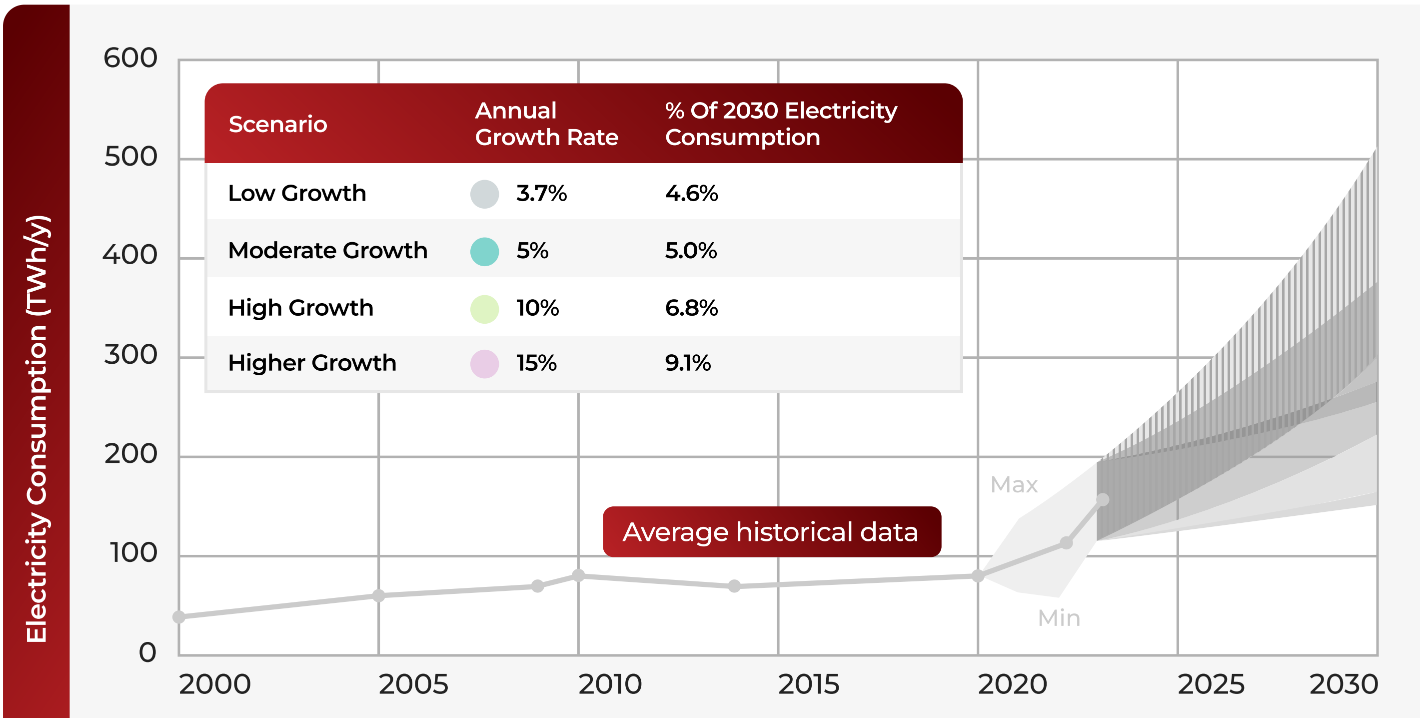


Figure ES-1. *Projections of potential electricity consumption by U.S. Data Centers: 2023-2030. % of 2030 electricity consumption projections assume that all other (non-data center) load increases at 1% annually.*

(**Source:** EPRI: Powering Intelligence: Analyzing Artificial Intelligence and Data Center Energy Consumption)

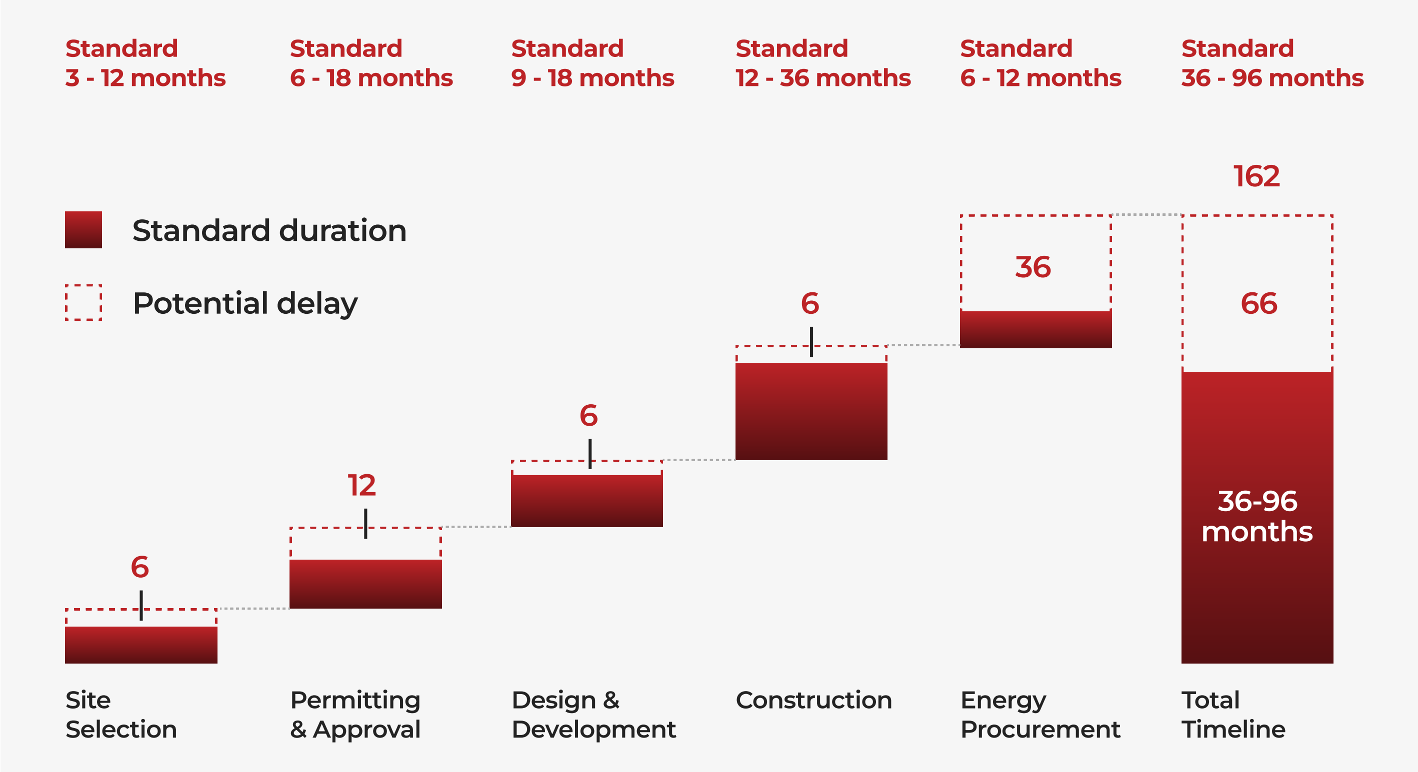
The IceBrick technology from Nostromo Energy is particularly suited to data centers given its small footprint, installation simplicity, and being 100% US made, which ensures long-term certainty of price and availability.

The IceBrick management system enables automated synchronization with other onsite energy resources as well as grid signals, to optimize value and increase ROI. It also serves as backup to the facility's cooling system, enhancing resilience and reducing redundancy needs.

Solving Grid Capacity Constraints with On-site Energy Storage

Data centers demand for electricity is projected to triple by 2030 and may reach up to 12% of total U.S. electricity consumption.[3] In Virginia ("data centers alley"), data centers are projected to consume between 29 and 46% of the total state power generated in 2030.[4] Utilities are not keeping up with this rapid growth, resulting in "time to power" extending 5 to even 7 years.[5,6] These delays are very costly for developers of new data centers, as well as existing operators seeking expansion to meet the demand of their customers. Most of the demand is fueled by the explosion of the AI market and a trillion dollars in projected investment in new data centers, which hinge on power resources. It is estimated that for a 100MW data center, a 2-year delay can cost between tens and hundreds of millions of dollars in lost revenue.[7]

Northern Virginia data center delays: impact of interconnection bottlenecks on timelines (months)



(**Source:** ImpactECI,2025)

[3] U.S. Department of Energy
[4] EPRI: Powering Intelligence: Analyzing Artificial Intelligence and Data Center Energy Consumption (May 2024)
[5] FTI Consulting (6/14/2024)
[6] Data Center Knowledge (3/17/2025)
[7] Based on SEC filings of major operators.

Building new capacity will not only take years, but also require major capital investments, triggering intensive debates as to who will bear this cost: The utilities (which means the ratepayers) or the data centers developers.[8] Some utilities are requiring new data centers to sign up long term "take or pay" power purchase agreements (more than 10 years) to secure their investment in new capacity. This creates a long-term financial risk for the data center and a disincentive to become more energy efficient.[9]

In order to make use of any capacity that is, or will become, available, grid operators and distribution utilities are offering priority to data centers (aka, "large loads") that can commit to curtail demand at peak times. Curtailment can be in different ways, such as

on request, a schedule, or through participation in demand response programs.[10] DOE's rulemaking request of FERC also proposes that interconnection studies for "flexible loads" will be only 60 days (as opposed to currently 6 to 24 months, depending on location).

The only way a data center can curtail significant loads, without slowing down or compromising its computing processes, is if it has an onsite energy source (aka, "behind the meter") that it can dispatch on demand. This can be either a power generator or energy storage. Generation has many advantages, but is expensive, requires special infrastructure (like gas pipes), more land, long permits (if at all permissible), and long lead times components, so it is less likely to significantly cut down time-to-power in all cases. Most generators are also more polluting, hurting the ESG performance of the operator or its customers or attracting resistance from local communities. On-site solar promotes ESG profile but it is not dispatchable, unless paired with storage and requires a lot of land.

[8] Utility Dive: Customers in 7 PJM states paid $4.4B for data center transmission in 2024: report (October 1, 2025).

[9] Data Centers Dynamic: AEP Ohio slashes data center pipeline by more than half (October 1, 2025)

[10] Utility Dive:Southwest Power Pool approves accelerated large load interconnection policy (September 17, 2025); Google Blog: How we're making data centers more flexible to benefit power grids (Michael Terrell, Head of Advanced Energy at Google, August 4, 2025)

Flexible Load Enabled by Behind-The-Meter Energy Storage

Energy storage may be a preferred option, because the duration of curtailment events is typically 2-4 hours,[11] and can be much faster to deploy. Two major data centers recently successfully accelerated their powering approvals based on their commitment to procure local storage capacity.[12] A storage system can be charged when grid power is cheap, clean and abundant, and then discharged at peak (or event), as self-supply, instead of using the grid when it is short in capacity.

Storage allows not only to curtail peak demand, but also to reduce electricity costs by utilizing time-of-use prices or through negotiating favorable pricing under bilateral PPAs by leveraging the flexible consumption profile. It can also help reduce associated emissions and improve the site's ESG profile, by shifting consumption from high to low carbon-intensive hours. It is a win-win for both the utility (that wants to

sell more power) and the data center (that can connect sooner). A key aspect of the financial analysis is that energy storage generally qualifies for both bonus depreciation, as well as investment tax credits through 2033 at a rate of up to 30%-50% of the project's eligible costs.[13]

Thermal Energy Storage (TES)

Energy storage has become synonymous with lithium-ion batteries, which are being deployed at large scale mainly to solve for the intermittency of wind and solar and their mismatch with the overall demand profile. These large, grid-scale (aka, "front of the meter") storage facilities are typically located in uninhabited areas near transmission lines. Battery storage directly serving specific users (aka "behind-the-meter"), are installed on the user's premises (inside the building or adjacent to it), and solves not only for the intermittency of renewables, but more importantly also for all

[11] See for example PJM ELRP demand response program.

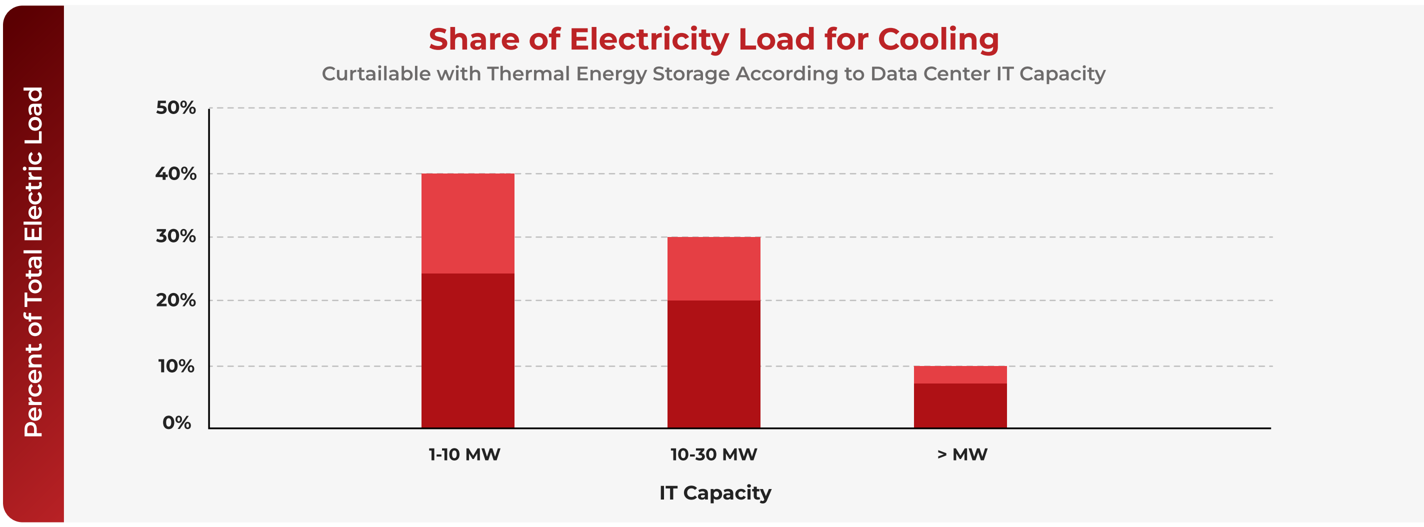
[12] "In a first, a data center is using a big battery to get online faster" (Canary Media, Oct 24, 2025); "OpenAI, Oracle, and Related Digital Announce Stargate Data Center Site in Michigan" (Related Digital, Oct 30, 2025).

[13] 30% (if certain labor requirements are met), 40% (if it also meets certain domestic content requirements) or up to 50% (if both the foregoing are met and the project is located in an "energy community").

the grid's capacity constraints including transmission and distribution and variable costs, by shifting consumption from peak to off-peak hours, as well as reducing the host's demand for power from the grid during peak hours or scarcity events, and also for backup power.

However, behind-the-meter storage has not been widely adopted by commercial and industrial facilities, mainly due to the safety issues with lithium-ion batteries, and the related regulatory and permitting conundrum, as well as their high cost.

Cold energy storage can provide the same benefits as battery storage for the electricity used for cooling, which can be up to 40% of a data center's electric load at peak hours.[14] By creating and storing thermal energy during off-peak hours, and then using it at peak, the cooling load is curtailed, without impact on computing. It can even be done daily to reduce electricity costs or earn revenues in the power market. Unlike lithium-ion batteries, thermal energy storage is completely safe and does not require any special permitting.



Cold Thermal Energy Storage (CTES) has been around for a few decades, but did not gain wide adoption mainly due to two limitations of traditional systems:

[14] U.S. Department of Energy

The first one is physical, as these legacy systems have a large footprint and weight and can only be mounted on a grounded base (which excludes rooftops for example). Second, they do not offer a dispatchable solution, meaning controlled variable discharge rate with a management system and grid-communication that enables grid-interactive operation, syncing discharge profile with grid constraints and generating revenue to the host. **Nostromo's IceBrick technology has overcome these challenges.**

The IceBrick® Technology

The IceBrick technology from Nostromo Energy is an ice-based cold energy storage system featuring patented storage modules and a highly advanced management platform (see brochure on how it operates, or visit www.nostromo.energy). The IceBrick technology is particularly suited for data centers as it overcomes the main challenges of the legacy TES systems:

Small Footprint The IceBrick storage modules are compact and modular. In a stacked formation they will use two-thirds of the space required by the next most energy-dense commercial TES product. In addition, the IceBrick system can discharge at a variable controlled rate, and fully discharge in less than 4 hours (which is the typical peak demand window), compared to other ice-based systems that typically takes about 8 hours to full discharge, 2-4 times the length of typical demand response events (2-4 hours). Accordingly, for the same amount of available energy during DR events, the IceBrick system only needs about a third of the space as the next most energy-dense technology.

High Reliability. The IceBrick robust encapsulated ice design is well protected against leakage of the coolant into the energy-storage water media. The IceBrick ice-capsules are tested rigorously prior to final assembly ensuring only 1% degradation after 6,600 cycles (representing about 20 years of daily use). In an unlikely event of coolant leakage contaminating the encapsulated water media, only the affected capsule will be disabled, which is only 0.5% of the storage capacity of a full IceBrick module. Accordingly it comes with a 10-year manufacturer's warranty, which can be extended to 20 years.

Management. The IceBrick technology features an advanced communications and control platform that enables synchronization with the grid (demand response or wholesale market bidding) while maintaining site priorities (operational or financial).

Full Control. The IceBrick design enables the system to generate a very steady energy output, which can also be varied as needed (high or low) to quickly respond to changing energy needs.

The IceBrick technology has been evaluated extensively by credible, independent third parties, including the U.S. Department of Energy (through its Loan Programs Office), the Lawrence Berkeley National Lab (for the U.S. General Services Administration) and Shell (in its Game Changer Program). Regarding integration with the power grid, the California Public Utilities Commission approved the IceBrick systems as standalone demand response resources and awarded it qualified capacity (aka, “resource adequacy”), which utilities can purchase to meet their capacity obligations. It was similarly registered by CAISO as a “standalone” demand response resource, allowing it to bid its load reduction to the wholesale energy market directly (without aggregation).

Finally, the IceBrick proprietary components are manufactured fully in the U.S., ensuring availability and price certainty, as well as the 10% investment tax credit adder for “domestic content” (total 40% credit).

To discuss the IceBrick technology further and how it can help your data center expand capacity, connect faster or be more efficient, please write to us at info@nostromo.energy and we’ll get back to you shortly.

Appendices: IceBrick360 Technical Specifications Brochure