

MODULAR DATA CENTER DEVELOPMENT

Community Information

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Introduction

The Data Center Resource Hub provides research-based information on large-scale (hyperscale) data center development. This supplement is intended to provide parallel information on a smaller, distinct category of facility: the modular data center.

Modular data centers operate on average around 1 to 20 megawatts (MW), are sited on small parcels at locations where electric capacity already exists, and are built and decommissioned on a different timeline and scale than hyperscale campuses. They are not portable shipping-containers. They are permanent, permitted facilities that use pre-engineered, factory-built containerized modules delivered to the site and connected to existing distribution-level utility infrastructure.

Most modular data centers are intended to support inference (the day-to-day delivery of AI services), industry-specific AI applications, and local data processing — distinct from the large-scale training and cloud workloads that drive hyperscale development.

The information below is structured to mirror the existing Data Center Resource Hub fact sheets so policymakers and community members can compare the two scales side-by-side.

A Note on Category

The Data Center Resource Hub identifies seven categories of data center, including a category for modular data centers. The existing fact sheets primarily address hyperscale facilities. This supplement is intended to fill that gap with parallel, research-based information specific to the modular category.

Fact Sheet 1: What Modular Data Centers Are

Modular data centers are permanent, permitted, containerized facilities that operate on average in the 1 to 20 MW range. They are characterized by:

- Pre-engineered modules manufactured off-site and delivered by truck to a prepared site.
- Sites typically 1 to 5 acres in total area.
- Connection to existing distribution-level electric service, with no or minimal need for new transmission lines or major substation upgrades.
- Closed-loop liquid cooling with dry heat rejection (air-cooled chillers), eliminating continuous evaporative water use.
- Unmanned operation, monitored remotely, with routine site visits.
- Designed to be removable: modules disconnect at end of life, foundations are removable, and the land can be restored to its prior use which commonly is cultivated croplands.

What Modular Data Centers Are Not

Modular data centers are sometimes confused with two adjacent categories:

- **Portable / shipping container compute.** These are containerized compute units delivered to a job site for temporary use. Modular data centers, by contrast, are permitted, permanent facilities. Modules are delivered to the site, set on prepared foundations, connected to utilities, and operated for the life of the facility.
- **Hyperscale facilities.** Hyperscale data centers operate at 100+ MW on land assemblies of 50 to 500+ acres, with multi-year construction. Modular data centers operate at 1 to 20 MW on 1 to 5 acres, with construction timelines measured in months.

Typical Applications

- **Inference and AI service delivery.** The day-to-day operation of AI-powered applications: search recommendations, chat assistants, photo enhancement, customer service tools. This is the application layer of AI.
- **Specialized AI for industries.** Tools for medical records, legal research, agriculture, manufacturing, and other industries that benefit from domain-specific AI rather than general-purpose chatbots.
- **Local data processing.** Real-time computing close to where data is generated, supporting emergency response routing, grid load balancing, outage prediction, weather, and surveying.

Bottom Line

Modular data centers are smaller, distributed facilities that support the day-to-day delivery of AI services and local computing needs. They are a distinct category from both hyperscale facilities and portable container compute.

Fact Sheet 2: Land Use & Site Design

Key Facts

- Modular data center sites are typically 1 to 5 acres in total area.
- That footprint is roughly equivalent to 1 to 4 football fields. A hyperscale campus, by comparison, occupies roughly 40 to 400 football fields.
- Most of the site footprint remains pervious surface: gravel access drives, grass, and vegetation. Concrete is used only where structurally required.
- Structures are single-story modular enclosures, generally sized to stay below the existing tree line. There are no campus-scale buildings.
- Sites are removable: modular units disconnect and truck out at end of life. Foundations are removable. The land can be returned to its prior use.
- Routine traffic is minimal. The site is unmanned. Maintenance visits are typically a few times per month — far less than commercial uses.

Comparison: Land Footprint

Metric	Modular Data Center	Hyperscale Data Center
Total site area	1 – 5 acres	50 – 500+ acres
Football fields equivalent	1 – 4	40 – 400
Structure height	Single-story; below tree line	Multi-story; campus scale
Surface treatment	Mostly pervious (gravel, grass)	Predominantly hardscape (concrete, asphalt)
Operations staffing	Unmanned; remotely monitored	Hundreds of on-site personnel
End of operational life	Removable; land restorable	Permanent industrial site

Bottom Line

Modular data center sites are sized to the available, stranded grid capacity. The land use footprint is comparable to a small commercial or agricultural parcel rather than to a hyperscale industrial complex, and the site can be fully decommissioned at end of operational life.

Fact Sheet 3: Water Usage

Key Facts

- Modular data centers use closed-loop liquid cooling with dry heat rejection (air-cooled chillers). The cooling fluid is a sealed loop, with no evaporative use during normal operation.
- A 10 MW modular site uses approximately 14,000 to 16,000 gallons of water for a one-time initial fill. That is less than a typical residential swimming pool, which holds 15,000 to 20,000 gallons.
- After the initial fill, only small top-offs are needed for ongoing maintenance. There are no scheduled full-system blowdowns and no continuous wastewater discharges.
- Closed-loop cooling fluid contains food-grade glycol, corrosion inhibitors, and biocides. The cooling liquid does not contain PFAS. The fluid is typically changed every 5 to 8 years by licensed waste handlers with chain-of-custody documentation.

Approximate Initial Fill by Facility Size

Facility Capacity	Approximate Initial System Fill (one-time)
2 MW	2,800 – 3,200 gallons
4 MW	5,600 – 6,400 gallons
6 MW	8,400 – 9,600 gallons
8 MW	11,200 – 12,800 gallons
10 MW	14,000 – 16,000 gallons

Comparison Context

For comparison, the Microsoft hyperscale data center under construction in Mount Pleasant, Wisconsin is projected to use approximately 8 million gallons of water per year, equivalent to roughly a dozen Olympic-sized swimming pools annually. A 10 MW modular data center uses less water for its initial fill than a single residential swimming pool.

Bottom Line

Modular data centers use closed-loop cooling that eliminates evaporative water use. A 10 MW modular facility's initial fill is comparable to one residential swimming pool. The water impact on local supplies is minimal.

Fact Sheet 4: Noise & Lighting

Noise

- Modular data center noise is designed to meet 40 to 50 dBA at the nearest residence — comparable to a normal conversation or library.
- Noise at the facility fence line is typically around 70 dB, comparable to traffic.
- Most projects include an independent third-party acoustic study reviewed against health-based guidelines.
- If additional protection is needed, low-noise equipment, sound walls, or site adjustments can be added.
- Noise impact is dependent on site geography, setbacks, and equipment configuration. Site-specific modeling is conducted during permitting.

Noise Comparison

Source	Typical Sound Level
Whisper	20 dB
Library	40 dB
Modular data center, measured at nearest residence (design target)	40 – 50 dBA
Normal conversation	60 dB
Modular data center, at facility fence line	~70 dB
Traffic	70 dB
Typical hyperscale data center	85 dB
Jet engine	100 dB

Lighting

- Exterior lighting uses dark-sky compliant fixtures: downward-directed to eliminate light pollution and glare on adjacent properties.
- Motion-activated where feasible. Numerous exterior lighting activates only on motion or scheduled inspections, not 24/7.
- Interior lighting is minimal. Equipment enclosures are sealed and visually self-contained, with no interior illumination visible from outside.

Bottom Line

Modular data centers are engineered to operate at conversational noise levels at the nearest home, with night-sky-friendly lighting and minimal on-site activity outside of scheduled maintenance.

Fact Sheet 5: Grid & Energy

Key Facts

- Modular data centers are sized to fit within stranded, existing grid capacity. Sites are selected where distribution-level capacity is already available, avoiding new costly transmission lines or major substation upgrades.
- The facility operates under a contracted electric rate provided by the utility, which is approved by the Public Service Commission or by a cooperative's Board of Directors. The rate is structured to fully recover the utility's cost to serve the load.
- A modular data center is a steady, high-load-factor customer — operating near its rated demand around the clock. This spreads the utility's fixed costs across more kilowatt-hours sold.
- No cross-subsidy from residential, commercial, or industrial members. The facility pays for the power it consumes plus its share of fixed costs.
- Standard load ranges from 1 to 20 MW, compared to 100+ MW for a hyperscale facility.

Comparison: Grid Impact

Metric	Modular Data Center	Hyperscale Data Center
Typical load	1 – 20 MW	100+ MW
New transmission required	No	Often yes
New substation required	Generally no	Generally yes
Rate recovery	Dedicated rate covers cost to serve	Dedicated rate covers cost to serve
Effect on fixed cost recovery	Spreads across more kWh sold	Significant capacity addition required first
Cross-subsidy risk to residential	None by design	Mitigated by tariff design

The Distributed Grid Argument

The modular data center model is fundamentally different from the hyperscale model in how it interacts with the grid. Hyperscale facilities consolidate demand at a single location, generally requiring new transmission, new substations, and in many cases new on-site generation. Modular facilities distribute demand across many smaller sites, each sized to the capacity that already exists at that location.

From a cooperative or municipal utility's perspective, a steady high-load-factor customer at distribution voltage is generally favorable. The load factor is high (the facility runs near its rated demand most hours), the location is close to existing infrastructure, and the rate is designed to recover full cost to serve.

Bottom Line

Modular data centers are designed to fit the grid that exists today, not to require a new one. By matching a small modular load to available capacity, the model avoids transmission and substation upgrade costs. A steady, high-load-factor customer also helps spread fixed grid costs across more units sold over time.

Fact Sheet 6: Construction & Site Infrastructure

Key Facts

- Construction timeline is typically 4 to 8 months from start to operations, compared to 2 to 4 years for a hyperscale facility.
- Modular units are pre-built off-site at a manufacturing facility and delivered by truck. Most on-site work is foundation preparation, fencing, and utility tie-in.
- There is no multi-year construction site. Construction traffic, which is minimal, is concentrated in a short window.
- Foundations are pre-engineered concrete piers or pads, sized to each modular unit. There is no building-scale foundation.
- Access drives are typically gravel, with concrete used only where structurally required. Most of the site footprint stays pervious surface.
- Three-phase power is routed adjacent to the site from the utility’s existing distribution system.
- Fire suppression uses clean-agent gas-based systems (FM-200 or Novec). No large water tanks. No sprinkler infrastructure.
- Operations are unmanned and monitored remotely. Routine site visits are held to ensure proper operations and maintenance thus generating far less traffic than commercial uses.
- Security includes perimeter fencing, badge-controlled gate, locked equipment cabinets, and 24/7 remote monitoring with alert dispatch.

Comparison: Construction Profile

Metric	Modular Data Center	Hyperscale Data Center
Timeline to operations	4 – 8 months	2 – 4 years
On-site construction footprint	Single small parcel	Large multi-year staging
Foundation type	Modular concrete piers / pads	Building-scale foundations
Surface treatment	Mostly gravel; pervious	Predominantly concrete / asphalt
Operations staffing	Unmanned; remote monitoring	On-site staff and contractors
Site at end of life	Removable; land restorable	Permanent industrial site

Bottom Line

A modular data center site is delivered and operating in months, not years, and is sized like a small commercial parcel rather than an industrial campus. The construction impact on the host community is short, well-defined, and reversible.

Fact Sheet 7: Economic & Community Benefits

Tax Base

- Modular data centers generate meaningful property tax revenue relative to the land area they occupy. On a per-acre basis, modular data centers typically produce multiples of the tax revenue of comparable industrial or warehouse uses.
- The asset mix (modules, electrical equipment, supporting infrastructure) creates a tax base that adds value without requiring large land assemblies or extensive municipal services.
- Tax revenue supports local governments, schools, roads, and emergency services in host jurisdictions.

Cooperative & Utility Revenue

- Where served by a rural electric cooperative, the load strengthens the financial position of the member-owned utility.
- A high-load-factor customer adds revenue that supports system maintenance, reliability investment, and rate stability for all members.
- Modular data centers are located adjacent or in close proximity to existing distribution infrastructure, minimizing the need for new utility investment.

Local Economic Engagement

- Construction engages local contractors and suppliers for site work, fencing, electrical work, concrete, and modular delivery and rigging.
- Landowner compensation is typically structured through competitive long-term lease agreements.
- Operating sites engage local emergency services, security providers, and maintenance contractors.

Community Investment

- Modular data center developments commonly invest in emergency services, STEM education, and civic partnerships in host communities.
- Long-term partnerships are designed to create lasting value through reliable infrastructure investment.

Distributed Model: Many Small Sites, Not One Large Campus

A defining feature of the modular data center model is geographic distribution. Rather than concentrating demand and impact in a single host community, the model places smaller facilities across multiple communities. From the host community's perspective, this means:

- Smaller scale of disruption during construction and operations.
- Tax base and utility revenue without large-scale industrial infrastructure.
- Lower risk of overloading municipal services, schools, roads, or utilities in any single community.

Bottom Line

Modular data centers concentrate meaningful long-term tax base and utility revenue on a small parcel, without the large land assemblies, water demand, or transmission costs of hyperscale facilities. The model is designed for distribution: many small sites across a region rather than one large campus in one community.

Q&A: Modular Data Centers

Q: What is the difference between a modular data center and a hyperscale data center?

A: Hyperscale data centers are large, centralized facilities, typically 100+ MW of demand, built on land assemblies of 50 to 500+ acres, with multi-year construction timelines. They support cloud, training, and large-scale data storage. Modular data centers are smaller, distributed facilities, typically 1 to 20 MW, built on 1 to 5 acres at sites where electric capacity already exists, with construction timelines of months rather than years. They commonly support inference (the day-to-day delivery of AI services), industry-specific AI, and local data processing.

Q: Are modular data centers the same as portable or shipping container compute?

A: No. While modular data centers use pre-engineered, factory-built enclosures that resemble shipping containers, the sites themselves are permitted, permanent facilities. Modules are delivered by truck, set on prepared foundations, connected to utilities, and operated for the life of the facility. They are removable at end of life, but they are not moved during operations.

Q: How much water does a modular data center use?

A: Modular data centers use closed-loop liquid cooling with dry heat rejection. A 10 MW site uses approximately 14,000 to 16,000 gallons for a one-time initial fill — less than a typical residential swimming pool. There are no scheduled full-system blowdowns or continuous wastewater discharges. After the initial fill, only small top-offs are needed for maintenance.

Q: Will a modular data center increase electric rates in my community?

A: No. Modular data centers operate under rates approved by the Public Service Commission or by a cooperative's Board of Directors. These rates are designed to recover the utility's full cost to serve the load. Because a modular data center is a steady, high-load-factor customer, it spreads the utility's fixed costs across more kilowatt-hours sold, which can apply downward pressure on rates for other members over time.

Q: Will I be able to hear the data center from nearby homes?

A: Modular data center noise is designed to meet 40 to 50 dBA at the nearest residence, comparable to a normal conversation. Most projects include an independent third-party acoustic study. If additional protection is needed, low-noise equipment or site adjustments such as sound walls can be incorporated into the design.

Q: What about light pollution and night sky impact?

A: Exterior lighting is dark-sky compliant: downward-directed, and motion-activated where feasible. The site is generally dark at night unless someone is on site for maintenance.

Q: How much traffic will the site generate?

A: Modular data centers are unmanned and operate remotely. Routine site visits are typically a few times per month, generating far less traffic than commercial uses or warehouses.

Q: What is in the cooling fluid? Does it contain PFAS?

A: Closed-loop cooling fluid contains food-grade glycol, corrosion inhibitors, and biocides. It does not contain PFAs. The fluid is typically changed every 5 to 8 years by licensed waste handlers with chain-of-custody documentation.

Q: What happens at the end of operational life?

A: Modular units disconnect and truck out. Foundations are removable. The land can be fully restored to its prior use. The site is removable by design — a deliberate contrast to the permanent industrial footprint of hyperscale facilities.

Q: What jobs does a modular data center create?

A: Modular sites support construction and trades jobs during the build phase (concrete, fencing, electrical, site work, delivery and rigging). Once operational, the site itself is unmanned, but the facility supports ongoing engagement with local suppliers, contractors, and emergency services. The primary economic benefits are property tax base, community investments, utility revenue, and infrastructure investment rather than large direct on-site employment. Communities evaluating modular projects should weigh tax, community investment and utility revenue per acre rather than headcount.

Q: Does heat from the facility raise local temperatures?

A: Published research on data center waste heat and ambient temperature effects has primarily focused on large facilities (100+ MW) in hot, dry climates. At the scale of a modular data center (1 to 20 MW) in a temperate climate, measurable effects on local ambient temperature are not expected. Specific site studies can be performed during permitting where warranted.

Q: Who pays for new electric infrastructure if it's needed?

A: The modular data center model is specifically designed to use existing distribution capacity, avoiding the need for new transmission or major substation upgrades. Where any minor utility upgrades are needed, they are funded by the project through the contracted rate and not passed on to other ratepayers.

References & Further Reading

The following are third-party, research-based sources that policymakers and community members can review for further context on data center development at both hyperscale and modular scale. Sources are organized by category.

Federal & National Laboratory Sources

- **Lawrence Berkeley National Laboratory** — *2024 United States Data Center Energy Usage Report* (prepared for the U.S. Department of Energy, December 2024). The federal baseline study on U.S. data center energy use and growth projections.
- **U.S. Department of Energy, Loan Programs Office** — guidance and analysis on distributed compute, grid utilization, and infrastructure investment.
- **Federal Energy Regulatory Commission (FERC)** — docket materials and orders on large-load interconnection.

Industry & Technical Sources

- **Electric Power Research Institute (EPRI)** — *Powering Intelligence: Analyzing Artificial Intelligence and Data Center Energy Consumption* (2024). The most-cited industry source on AI-driven load growth, differentiating between inference and training workloads.
- **Uptime Institute** — *Global Data Center Survey* (annual) and water and PUE reporting. Independent industry benchmark.
- **International Energy Agency (IEA)** — *Energy and AI* (2025). International, neutral framing on AI as infrastructure.

Cooperative & Utility Sources

- **National Rural Electric Cooperative Association (NRECA)** — guidance and case studies on cooperative-served industrial loads, useful context for projects served by rural electric cooperatives such as Dunn Energy, Jump River Electric, Oakdale Electric, and similar.
- **Public Service Commission of Wisconsin** — docket materials on data center tariffs, including the large-load tariff structures used for Wisconsin hyperscale projects.
- **American Public Power Association (APPA)** — large-load tariff design literature and case studies.

Academic & Independent Research

- **Arizona State University** — published research on data center waste heat and ambient temperature effects. Notes that effects are most pronounced for large facilities in arid climates and explicitly contextualizes findings against scale and geography.
- **National Renewable Energy Laboratory (NREL)** — research on distribution-voltage industrial loads and grid-edge resources.

State & Regional Sources

- **Wisconsin Economic Development Corporation (WEDC)** — state-level data center positioning and economic development resources.
- **Wisconsin Counties Association** — county-level guidance on industrial development.
- **Wisconsin Department of Natural Resources** — permitting guidance relevant to siting, stormwater, and air permits.
- **Milwaukee 7 (M7) Data Center Resource Hub** — the source material adapted for the Momentum West hub, with additional fact sheets and project profiles for southeastern Wisconsin developments.

Notes on Sources & Terminology

Terminology

This supplement uses the term "modular data center" to align with the Data Center Resource Hub's existing categorization. Other industry terms in use for the same category of facility include:

- Modular compute center
- Small modular compute center
- Edge data center (where the focus is on geographic proximity to end users)
- Distributed compute center

The defining characteristics of this category are: site size (typically 1 to 5 acres), electrical demand (typically 1 to 20 MW), construction approach (pre-engineered modules manufactured off-site), and grid integration (distribution-level, no new transmission required).

How This Supplement Was Prepared

Information in this supplement reflects published research, industry technical specifications, and operating practice for modular data center facilities. Comparison figures for hyperscale facilities are drawn from the same sources referenced in the existing Data Center Resource Hub fact sheets, including project-specific data for Wisconsin developments such as the Microsoft facility in Mount Pleasant.

Caveats

Specific facility characteristics vary by developer, site, and project. The figures presented here reflect typical ranges for the modular data center category and are intended for policymaker and community information rather than for specific project evaluation. Any specific project should be evaluated against its own engineering documentation, permit submittals, and host community agreements.

Note on Existing Hub Fact Sheets

Two minor inconsistencies in the existing hub fact sheets are worth flagging for future revisions:

- Fact Sheet 4 (Energy & Water Q&A) states the Mount Pleasant Microsoft facility uses approximately 8 million gallons per year (about a dozen Olympic pools). Fact Sheet 5 (Water) states approximately 8,000 gallons per day for the same facility, and references four Olympic pools. $8,000 \text{ gpd} \times 365 \approx 2.92 \text{ million gallons per year}$, which conflicts with the 8 million figure on Sheet 4. The original Milwaukee 7 source page references four Olympic pools annually. Worth reconciling before further distribution.
- The hub's brief description of "Modular Data Centers" combines truly portable plug-and-play container compute with permitted modular facilities, which are operationally and regulatorily distinct. This supplement is intended to draw that distinction clearly.