Data Center Conservation and Grid Impact

2026

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Introduction: Mike Bryan

- Mike Bryan, CEO & President
- 28 years experience
- Former primary role - data center commissioning

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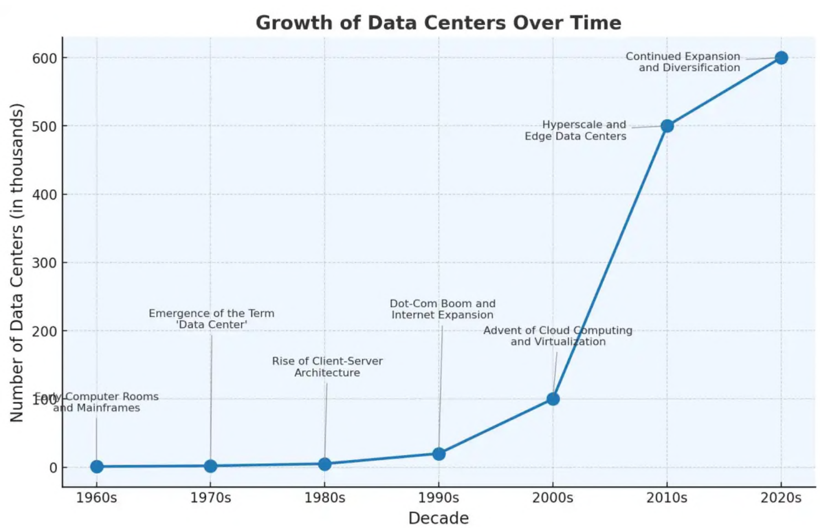
Agenda

- Data centers
- Industry trends including conservation
- What does it mean for the utility?

The rise of Data Centers



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The Rise of Data Centers

- Data-center power demand hits 106 gigawatts (GW) by 2035 in BloombergNEF forecast
- BNEF's newest forecast – a 36% jump from the previous outlook, published just seven months ago.
- Of the nearly 150 new data center projects BNEF added to its tracker in the last year, nearly a quarter exceed 500 megawatts. That's more than double last year's share.

What's driving the Influx?

- Why are we seeing so many data centers?
  - Rapid growth driven by AI and cloud demand
- Why now?
  - Cloud compute
  - AI arms race
- Is speed to market a concern?
  - Now almost exclusively

What is a Data Center?

- Facility housing servers, storage, and networking
- Supports:
  - Cloud computing
  - Applications
  - Data storage and processing
- Operates 24/7 with high reliability requirements

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Why Data Centers Matter

- Backbone of the digital economy (cloud, AI, apps)
- Enables:
  - Business operations
  - Financial systems
  - Communications
  - Storing of your photos and sharing what your dog did
- H1 of 2025 AI spend contributed 1.1% to GDP growth which was more than the American consumer
- Dominating the construction market in the US

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Types of Data Centers

Type	Definition/Overview	Typical Size Range (MW)
Hyperscale Campus Data Center	Campus with multiple hyperscale data centers.	100-2200
Hyperscale Data Center	Large-scale facilities that offer extensive space, power, cooling and infrastructure to support massive data and cloud and AI computing operations	50-180
Enterprise Data Center	A data center that is owned and operated by a single organization to support their IT needs	5-30
Colocation Data Center*	Space within a building, owned or leased by a company, that is rented out to third parties for their networking equipment or server storage	1-10
Edge Data Center	Smaller facilities located close to populations they serve that deliver cloud computing resources and cached content to end users	<2

Design - Redundancy & Reliability

- Goal: zero downtime
- Eliminate single points of failure
- Common designs:
  - N (base)
  - N+1 still the most used (backup component)
  - 2N mostly enterprise (full duplication)

Design - Electrical

- Enterprise
  - UPS (battery backup)
  - Emergency generator capacity that matches or exceeds utility capacity
  - Multiple power paths for maintenance
  - Closed transition transfers from generator to utility
- Newer hyperscale designs
  - Less UPS – core network infrastructure
  - Higher dependency on utility grid stability
  - Onsite emergency generation varies
  - Typically, open transition transfers

Design - Mechanical

- Enterprise and hyperscale
  - Chiller plants with cooling towers and thermal storage tanks
  - Evaporative cooling
  - Air handlers (AHUs) that utilize the chilled water to cool most spaces
  - Heat depends on location but typically electrical
- Newer hyperscale design changes
  - Chiller plants with glycol that are "sealed"
  - Higher load density means larger or more chillers
  - AI forcing a blend of cooling at the chip and AHU based

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Sustainability Considerations

- Energy efficiency
- Water usage (cooling)
- Renewable integration
- On-site generation / storage

Power Usage

- Power Usage Effectiveness (PUE) is the standard metric used to measure a data center’s energy efficiency.
  - It is the ratio of total facility power to the power delivered to IT equipment.
  - Measure of cooling demand and power delivery efficiency
  - 1.2 PUE is Good! 20% more power to support IT load.
  - 1.4-1.5 is still more typical.

Evolution of Cooling Designs

- Chillers with cooling towers (1.5 PUE)
  - Centralized and handle high loads well
  - Evaporate water via the towers (thousands of gallons a day)
- Direct or indirect evaporative cooling (1.2-1.3 PUE)
  - Lower to no need for compressors so less power used
  - Still evaporate a lot of water
- ”Sealed” chilled water systems with glycol
  - Initial water usage which can be in the millions of gallons
  - Little to no water usage after
  - Chiller based economizer resulting in lower power usage seasonally “free cooling”

Approach to Conservation - Cooling

- Cooling & Water Conservation
  - Many newer designs are trying to not evaporate water
  - Higher operating temperatures at the equipment and infrastructure rooms
  - Free cooling via chiller economizer modes that allow for seasonal cooling without compressors
  - Cooling at the chip is due to density but also creates more efficient cooling.
    - Air cooling is simple but inefficient when compared to cooling at the chip.
    - 75% direct to chip cooling and 25% air
  - Chiller plant equipment centralization to create less stranded capacity

Evolution of Power Designs

- UPS for all critical loads – 2N
  - High availability
  - Less efficient particularly in 2N (fully redundant designs)
- UPS for all critical loads with block redundancy
  - Example: 5 systems to provide the power of 4
  - Higher availability with higher efficiency
- UPS for only network infrastructure
  - Network has UPS backup
  - IT processing loads are direct fed utility power so lower losses and rackmount UPSs are used where needed

Evolution of Power Designs

- Distribution at 480 volt
  - 2-4 MW building/distribution
- Distribution at 15 kV
  - 10-20 MW building/distribution
- Site substations with distribution at 35 kV
  - 70 MW+ buildings
  - Onsite substation often dedicated takes delivery at transmission voltage
  - Higher voltage equals fewer power transformations

Approach to Conservation

- Less components
  - Power delivery at higher voltages with onsite substations
  - Fewer UPSs so one less power conversion
  - Higher distribution to the server racks (415 vs 208)
  - Eventual goal of direct 800 VDC to the server racks
- Power production onsite - Microgrids
  - Fuel cells
  - Natural gas generation
  - Solar (100+ acres for 20MW)
  - Battery Energy Storage Systems (BESS)

Approach to Conservation – Utility Impact

- Load Management
  - Are there opportunities for demand response participation?
  - Can backup batteries support the grid during peaks?
  - Are workloads movable between regions to reduce strain?
  - Is there any flexibility during emergency grid conditions?
  - As part of a microgrid is the utility one of many sources and does not serve the full demand?

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Trends Shaping the Future

- AI-driven power demand
- Cooling at the chip adoption
- Hyperscale growth
- Power-first site selection
- Distributed generation with data centers having onsite permanent generation
- Data centers building their own substations

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What Does it Mean for You - Power Demand & Grid Impact

- Extremely energy intensive
- Rapid load growth (AI, high-density racks)
- Utilities must plan for:
  - Load ramps
  - Large step loads
  - Potential power quality issues
  - Long-term capacity commitments
- Power availability is now the #1 constraint

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What can the Utility *actually* support?

Why 69kV and 115kV Fall Short

- Data centers 100 MVA and above push the limits of lower transmission voltages

69kV — Near Impossible

- 100 MVA at 69kV = 837 amps — at the ceiling of typical equipment ratings with no margin
- Coop and Muni 69kV systems were never designed to deliver this magnitude to a single customer

115kV — Marginal at 100 MVA, Impractical Above It

- 100 MVA at 115kV = 502 amps — workable for one transformer bank, but campuses rarely stop there
- 500 MVA at 115kV = 2,510 amps — exceeds practical equipment and line ratings
- Most 115kV systems lack the transmission capacity, bus ratings, and stability margin to aggregate 200–500 MW at a single point

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What can the Utility *actually* support?

230kV Is the Practical Minimum

230kV Works for the 100–500 MVA Range

- 100 MVA at 230kV = 251 amps
- 500 MVA at 230kV = 1,255 amps — manageable with appropriate substation design

Above 500 MVA, the Conversation Shifts Again

- 1 GW at 230kV = 2,510 amps — the same problem 115kV has at 500 MVA
- Hyperscale campuses at this scale require 345kV or 500kV interconnection
- This is no longer a local utility decision — NERC, FERC, and RTO involvement follows

What This Means for the Serving Utility

- 230kV infrastructure is often not in place — new construction may be required
- Who designs, funds, and owns that infrastructure is one of the most important negotiating points in any large data center agreement

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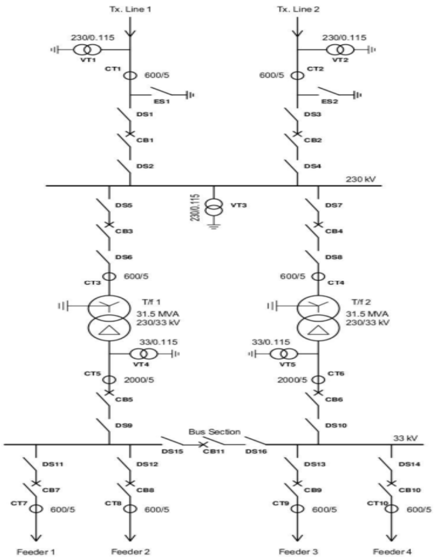
Ownership - Meter Point



Transmission

Transformer

Distribution

Pros vs. Cons – Who builds the substation?

Utility Builds It

Pros:

- Utility controls design, construction standards, and equipment specifications
- Protection settings, operating procedures, and switching authority remain in utility hands
- Asset stays on utility books — can be rate-based; retained if customer leaves
- Utility is an informed owner — knows every aspect of the facility for emergency response, fault clearing, and future modifications

Cons:

- Utility fronts significant capital — a new 230kV substation can run $30–80M or more
- Utility carries construction schedule risk on a customer demanding aggressive timelines
- Stranded asset exposure if the data center doesn't materialize or departs early

Pros vs. Cons – Who builds the substation?

Data Center Builds Their Own

Pros:

- No capital outlay for the utility; potentially no rate impact on other members or customers
- Data center's EPC contractors often build large substations faster than a utility can procure and construct
- Construction and schedule risk stays with the data center

Cons:

- Utility becomes an agnostic owner — less familiar with the design, equipment, and settings it must ultimately operate around
- Protection coordination requires careful utility review; errors create system-wide exposure
- Switching, clearances, and emergency access rights must be explicitly negotiated
- Long-term ambiguity: if the data center sells or vacates, who owns the infrastructure and under what conditions?

Challenges for Utilities

- Grid capacity constraints
- Long interconnection timelines
- Large, concentrated load growth
- Planning uncertainty
- Rates and impact to rate payers

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How to Prepare?

- Power Supply
  - Partnering with your G&T early to ensure generation and transmission availability. All parties involved need realistic timelines.
  - Be knowledgeable of the contracts and agreements you have with your G&T. How will you interact with them through this process?
- Legal
  - There will be a lot of contracts. Does your legal firm have the expertise or experience to do this?

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How to Prepare?

- Timelines
  - Data centers always come in real strong and pushy and state very aggressive timelines. They generally can't move as fast as they say they can.
- Engineering and Project Support
  - Who or what firm are you going to partner with that has the expertise to help you with the project.
  - How involved do you want to be? Do you have staff to support this? Will it be an EPC project?

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What is to come and takeaways?

- Continued data center growth (we have projects through 2028)
- There is a focus on costs which results in efficiency and conservation
- Political strife over the growth
- Data center onsite generation (nuclear?)
- Data center substation construction and ownership

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Questions?

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