AI Data Center Power Curtailment

Potential, Challenges, and Implementation

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In collaboration with Carbon Direct, Inc.

AI's scale has societal implications
...and new* reasons for power curtailment

Carbon

Marginal vs average carbon intensity of energy sources

New: Carbon capture and sequestration constraints

Power

AI data center power draw is immense and growing

New: AI training power swings

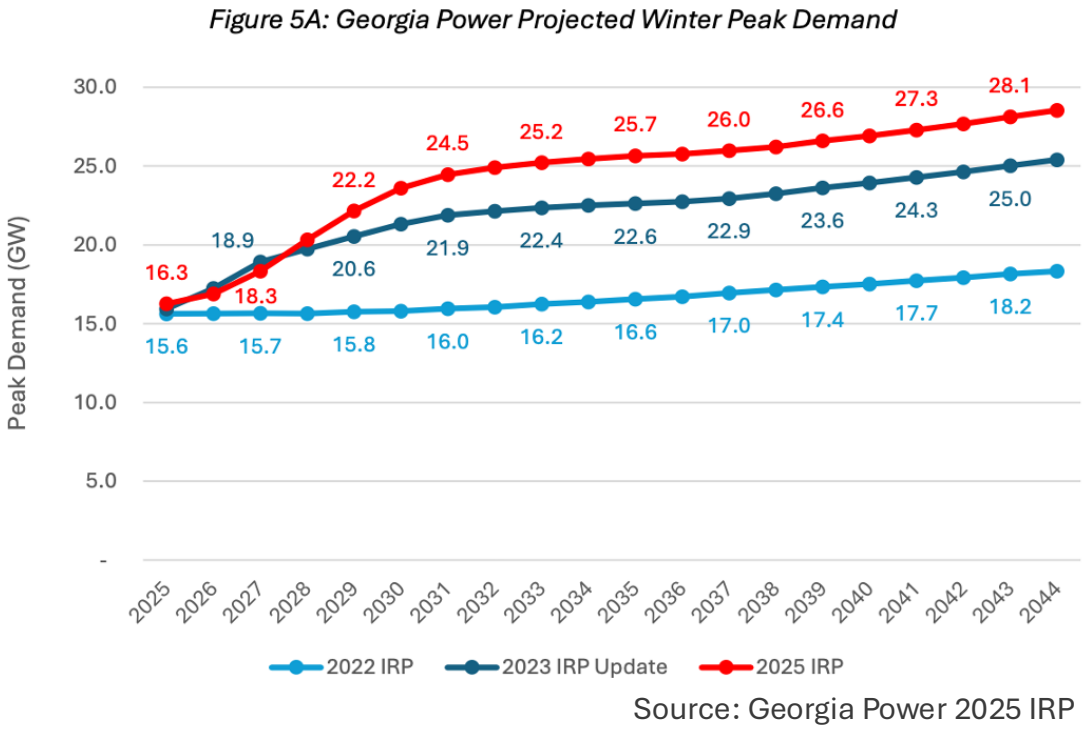
Water

AI data centers can consume millions of gallons of water per day

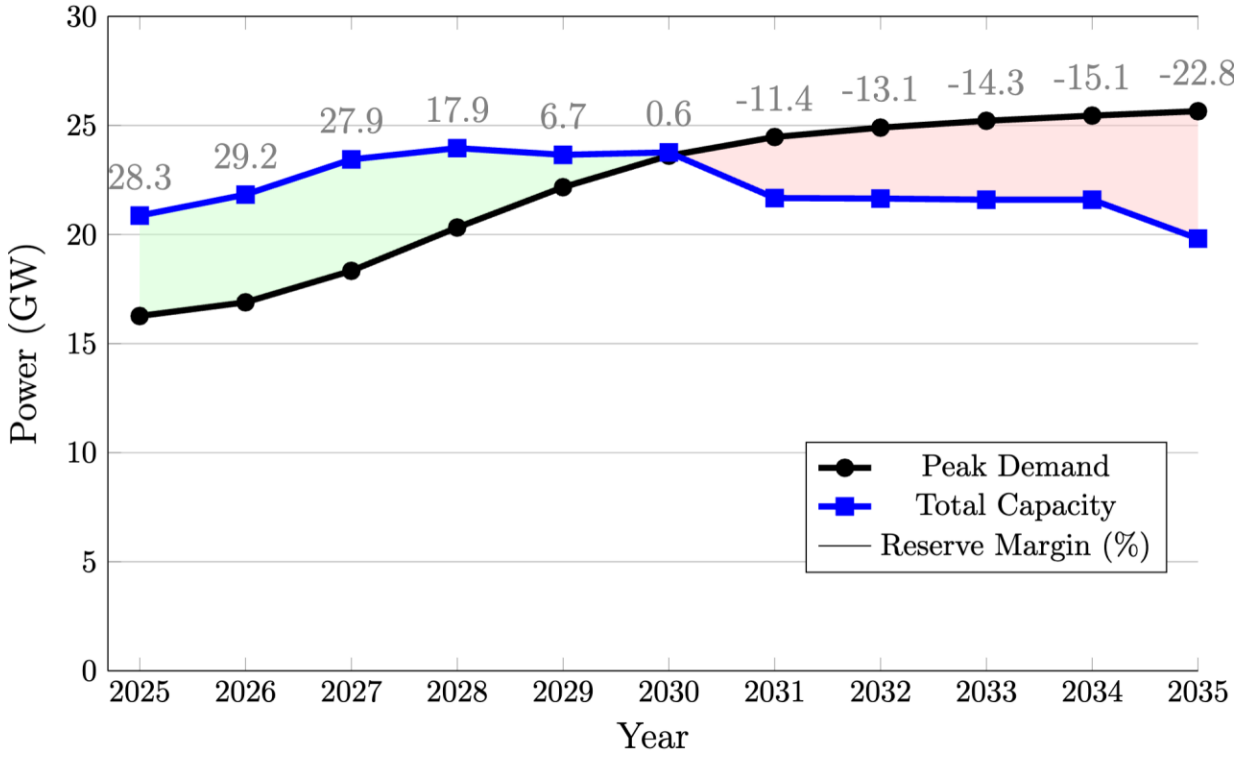
How can operations change during a drought?

This talk: AI Data Center Synergy with the Energy Grid

Problem – Meeting Unprecedented Power Demand



Source: Georgia Power 2025 IRP



"Elon Musk confirms xAI is buying an overseas power plant and shipping the whole thing to the U.S. to power its new data center"

- TomsHardware July 4th, 2025

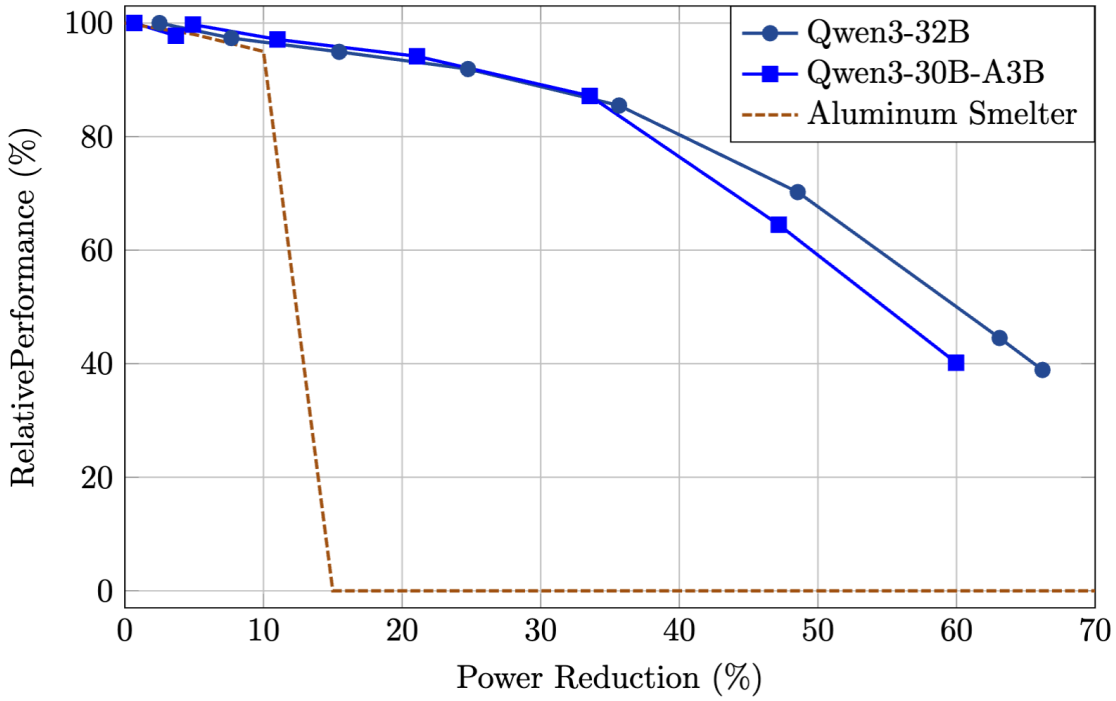
"US power generators pump the brakes on coal plant retirements"

- S&P Global Nov 5th, 2024

Opportunities

- Greater load curtailment opportunity
  - ORNL and Alcoa Inc in 2008:

    2.6 GW of combined load is "a significant opportunity to [supply] demand response services" [1]
- Nice power-performance profile
- Rarely, and shortly needed
  - Single-digit hour curtailment durations [2]
- GPU-Centrism
  - GPUs account for 45 – 86% of total rack power for modern AI systems
  - Simplifies modeling and control
- Alternative: Behind-the-meter generation
  - Rather than curtail power, use on-site backup batteries/generators



1. *"Providing Reliability Services through Demand Response: A Preliminary Evaluation of the Demand Response Capabilities of Alcoa Inc." 2009*
2. "Rethinking Load Growth: Assessing the Potential for Integration of Large Flexible Loads in US Power Systems" 2025

Challenges

AI System	Cost ($1k)	Peak Power (kW)	5yr Breakeven Power Cost ($/MWh)
GB200 NVL72	4,100	120	780
GH200	42.5	1	970
DGX B200 (estimate)	600	12.3	1,111

- Creating incentives and predictions
  - Energy Grid ↔ AI Applications/GPUs
  - How to manage shared data centers?
  - AI bubble?
- Financial incentive feasibility
  - Hardware opportunity cost vs peak energy cost
    - Modern AI systems breakeven power price: ~$1,000 / MWh*
  - Existing fixed-price power contracts
- Regulation
  - 6/20/2025 - Texas enacted Senate bill 6
    - *"large load customers with on-site backup generating facilities may be directed to either deploy the …[backups]… or curtail load"*
- Implementing power curtailment
  - Traditional shared HPC (and education): SLURM plugins
  - Emerald AI – start-up in this space

#SBATCH --gpu-freq <freq>
OR
#SBATCH --gpu-power <pow_cap>

AI data center power curtailment has immense, diverse, societal impacts.

Current focus: AI-energy grid synergy

Questions, discussions, collaborations?

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Other Good Resources:

utilitydive.com

datacenterdynamics.com