Data Center Energy Dispatch



Overview

Safe and Optimal Data Center Energy Dispatch with Deep This paper presents an optimization framework for data center energy dispatch that coordinates distr.

Key Takeaways

Data center energy dispatch involves optimizing electricity use by scheduling workloads, leveraging flexible loads, and integrating renewable energy to minimize costs and maintain grid stability.

Overview of Data Center Energy Demand

Data centers are major electricity consumers, with global demand projected to grow from 448 TWh in 2025 to 980 TWh by 2030, largely driven by AI-optimized servers, which will account for 44% of total power usage by 2030 (Gartner). In the U. S. and China, data centers are expected to consume a significant portion of regional electricity, highlighting the need for efficient dispatch strategies.

The sector already represents about 2% of global electricity consumption, growing at 15–20% annually.

Economic Dispatch and Flexibility

Data centers can act as flexible loads, adjusting power consumption to alleviate grid congestion. By modeling data centers with queuing-theoretic approaches and incorporating Quality of Service (QoS) cost functions, operators can optimize server utilization and workload shifting while respecting transmission constraints. Centralized economic dispatch models determine both power generation and data center workload allocation, whereas decentralized approaches use Lagrangian decomposition and dual gradient ascent algorithms to achieve tractable solutions.

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Microgrid and Multi-

Time Scale Dispatch

For data centers with on-site generation or microgrids, stochastic model predictive control can optimize energy dispatch across multiple time scales. Day-ahead scheduling considers batch workloads that can be delayed, while intra-day scheduling uses rolling optimization and feedback correction to adjust for real-time deviations in load and renewable output. This approach minimizes operating costs and ensures system stability.

Challenges in Grid Integration

Large data centers are not typical electricity customers; they require infrastructure negotiation with utilities due to their high and uncertain demand. Forecasting challenges arise when multiple projects request service simultaneously, leading to potential overestimation of load. Utilities like PJM and ERCOT have adapted by requiring firmer commitments and adjusting forecasting assumptions to manage these “phantom loads”.

Strategic ImplicationsAI Workload Management: Scheduling AI-intensive tasks during periods of lower grid demand or higher renewable availability can reduce costs and emissions. Renewable Integration: Dispatch strategies can incorporate solar, wind, or battery storage to smooth variability and reduce reliance on grid power. Economic Optimization: Combining day-ahead planning with real-time adjustments ensures cost-effective operation while maintaining QoS.

Decentralized Control: Distributed dispatch allows multiple data centers to coordinate energy use without centralized control, improving resilience and efficiency. Data center energy dispatch is therefore a multi-faceted optimization problem, balancing workload scheduling, grid constraints, renewable integration, and economic efficiency to meet the growing electricity demand of modern AI-driven infrastructure.

Article Content

Safe and Optimal Data Center Energy Dispatch with Deep

This paper presents an optimization framework for data center energy dispatch that coordinates distributed generators, renewable resources, and energy storage systems (ESS).

Data centre day-ahead energy demand prediction and energy

Based on the forecasted energy demand of the data centre, a Dynamic Combined Economic and Emission Dispatch (DCEED) optimization task is solved for a day-ahead period.

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Achieving Dispatchability in Data Centers: Carbon and Cost-Aware

This work provides a method to size a PhotoVoltaic (PV) system and an Energy Storage System (ESS) for an existing data center looking to reduce both its carbon footprint and demand stochasticity

Energy performance of data centres

A European database, prepared by the Commission, collects and publishes data, which is relevant for the energy performance and water footprint of data centres

Distributed Economic Dispatch in Power Networks Incorporating Data ...

We integrate DCs in a centralized economic dispatch problem that determines, apart from power generation, DC workload shifting and server utilization, while respecting transmission line constraints.

Achieving Dispatchability in Data Centers: Carbon and

This paper proposes an integrated planning scheme that optimally determines the locations and capacities of interconnected Internet data centers and battery energy storage systems

[2412.13853] Achieving Dispatchability in Data Centers: Carbon and

This work provides a method to size a PhotoVoltaic (PV) system and an Energy Storage System (ESS) for an existing data center looking to reduce both its carbon footprint and demand

Data Center Power Demand | MIT Energy Initiative

A single hyperscale data center can consume as much electricity as 50,000 homes. To address this complex challenge, the MIT Energy Initiative brings together MIT faculty members and scientists to

AEP, SoftBank and Commerce, Energy announce Ohio

The heads of the U.S. Departments of Energy and Commerce on March 20 announced a unique public-private partnership with SoftBank and AEP

Verse · Faster grid connection for the AI era

Verse delivers a path to power that gets your data center online up to 3 years faster. The energy infrastructure platform for the AI economy.

Verse Raises $54M and Launches “Dispatch Intelligence” to

Verse Raises $54M and Launches “Dispatch Intelligence” to Accelerate Speed to Power for Data Center Developers in Partnership with Calibrant Energy

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Ironton residents, city council concerned about data center

Ironton City Council hosted a special meeting Thursday, Jan. 8, 2025, for council members to ask questions about the new data center in Lawrence County, Ohio.

O''Leary Digital Builds 9 GW Utah AI Data Center Campus

Kevin O''Leary''s O''Leary Digital agreed on **June 4, 2026** to cut the footprint of its proposed **Stratos** data center campus in Box Elder County,

Data Center Energy Management: Microgrid Control & Grid Balancing

Integrated Power Generation & Microgrid Control for Data Centers Gain intelligent insights across your data center complex using Emerson''s innovative, integrated Ovation Automation Platform that

AI, Grids, and Electric Vehicles: Dispatch from the

BNEF expects power demand from data centers to more than double to reach 106 gigawatts by 2035. Developers are increasingly turning to behind

PJM trying to pass buck for Ohio''s power supply

PJM should take responsibility for its part in Ohio''s power shortfalls and soaring prices. Instead, it spreads misinformation.

DOE says data centers ''crucial'' for country''s future

Cedar Rapids —U.S. Department of Energy Deputy Secretary James Danly was in Iowa Tuesday, speaking on the virtues of data centers while calling for a “nuclear renaissance” in relation

States rush to regulate data centers amid noise,

Some states have offered tax incentives to attract high-tech data centers. But concerns about resources, waste and noise pollution are growing.

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