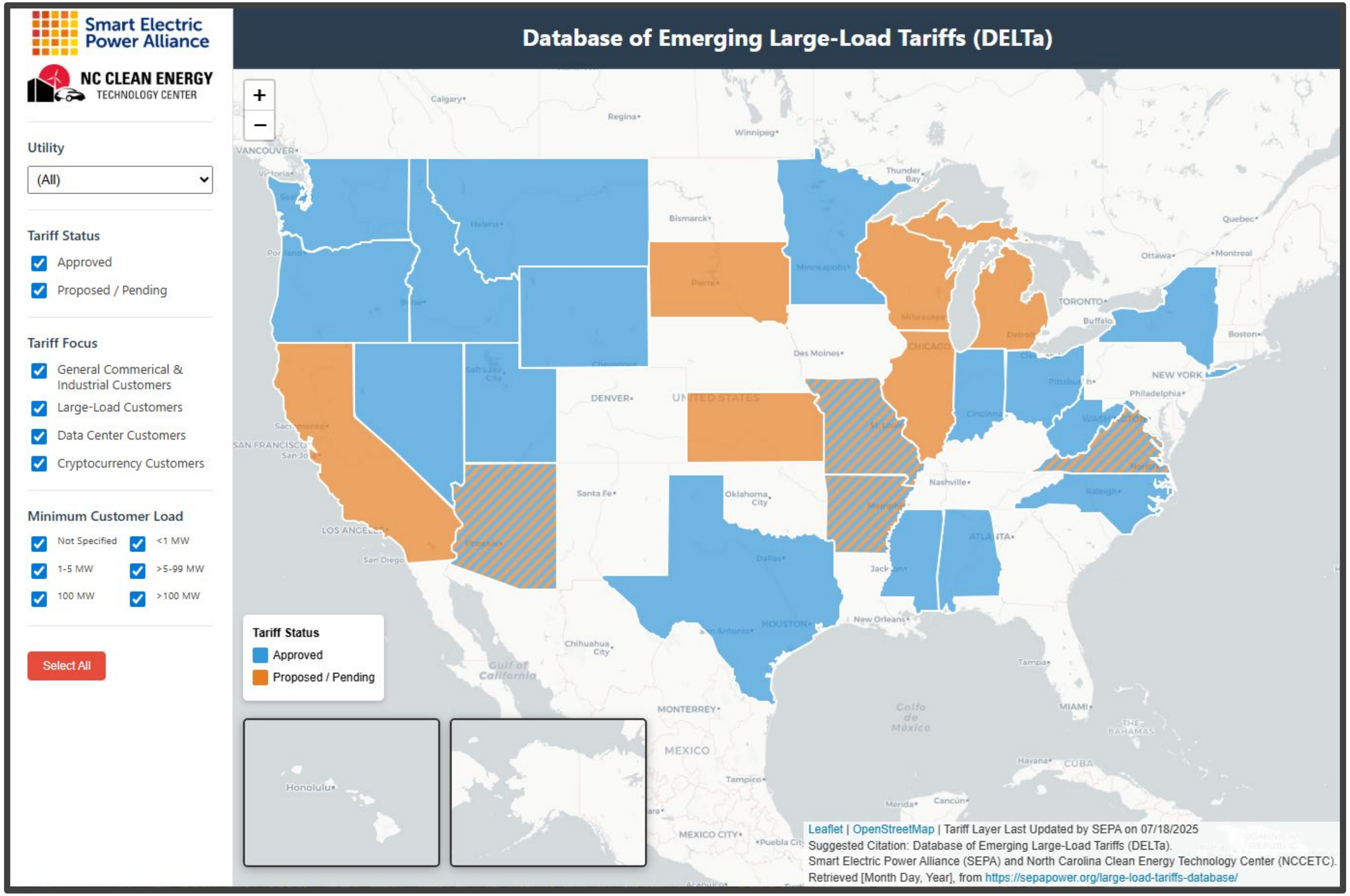
NARUC Summer Policy Summit

Emerging Practices for Designing Tariffs for New Large Load Customers

Committee on Electricity

Database of Emerging Large-Load Tariffs (DELTa)

Smart Electric Power Alliance



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Large Load Resources and Literature Review

National Association of Regulatory Utility Commissioners Summer Policy Summit

July 28, 2025

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ENERGY TECHNOLOGIES AREA
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Energy Markets & Policy
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TECHNICAL BRIEF 1 |

January 2025

Electricity Rate Designs for Large Loads: Evolving Practices and Opportunities

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Electricity demand from large-load customers such as data centers is projected to grow significantly in the near term. While these large loads play an important role in advancing technology innovation and economic growth in the United States, meeting their energy needs requires utilities and regulators to consider important financial and operational risks from underutilized investments or insufficient energy supply, infrastructure, and operational capabilities, with implications for all ratepayers. This paper provides an overview of how utilities and regulators are managing these risks through different tariffs, including rate structures and service agreements. Utilities, regulators, customers, and other stakeholders can use this paper as a foundation when discussing issues and sharing perspectives on developing new large load tariffs or reviewing existing ones.

Introduction

U.S. electricity demand is projected to grow significantly in the next decade, largely driven by data center expansion and artificial intelligence (AI) applications but also new domestic manufacturing and electrification in other sectors (NERC, 2024). While maintaining a reliable power grid at least reasonable cost and risk is always an imperative, ensuring new data centers have sufficient energy supply to maintain and continuously develop AI training models in the United States is vital for protecting national security and ensuring that AI systems are safe, secure, and trustworthy. The United States also has a strong interest in supporting the domestic development of AI applications, as they represent U.S. leadership in technology innovation and economic growth.

Reliable energy supply and robust infrastructure are critical to the successful deployment and expansion of large loads such as data centers. Data centers are among the most energy-intensive building types due to their continuous operation, computing equipment, and cooling needs.[1] Lawrence Berkeley National Laboratory estimates that total U.S. data center electricity demand more than doubled (2.3x) from 2018 to 2024 and could triple (3.3x) from 2024 to 2028 (Shehabi et al., 2024). Additionally, the power system impact of these customers may be particularly significant for individual utilities and regions. According to the Electric Power Research Institute (EPRI), 12 states accounted for 84% of data center growth since 2020 (EPRI, 2024).

Regulators, utilities, and large-load customers are exploring tariffs including rate structures, electric service agreements, and special contracts that achieve the objectives of reliable and affordable

Report available here

Four themes of large load tariffs we reviewed:

- Fairly allocate electricity system costs
- Mitigate utility and customer financial risks
- Mitigate operational and resource adequacy risks
- Accommodate the diverse needs of large-load customers

Data center literature review are in the slide appendix.

CENTER OF EXPERTISE FOR ENERGY EFFICIENCY IN DATA CENTERS

https://datacenters.lbl.gov/

DOE/LBNL data center program assists organizations with optimizing the design and operation of energy and water systems in data centers.

Assistance

- Project and technical assistance from the Center of Expertise including identifying and evaluating ECMs, M&V plan review, and project design review
- Support optimization of high-performance and enterprise data centers

Tools

- Data Center Profiler (DC Pro) Tools (x2)
- Air Management Tools (x3)
- IT Equipment Tool
- Electrical Power Chain Tool
- Energy Assessment Worksheets
- Data Center Master List of Energy Efficiency Actions

Key Resources

- Best Practices Guide for Energy-Efficient Data Center Design
- Center of Expertise Library – filterable list of reports, guides and presentations
- Small Data Centers, Big Energy Savings: An Introduction for Owners and Operators

Training

- Data Center Energy Practitioner (DCEP) Trainings
- Better Buildings webinar series
- On-demand FEMP data center trainings
- Center of Expertise Webinars

Large Load Literature Review

- Reviewed more than 40 publications and categorized into 11 themes.
  - Load forecasting
  - Reliabity and resource adequacy
  - Large load interconnection
  - Demand flexibility
  - Generation
  - Co-location
  - Data center location/infrastructure
  - Large load tariffs
  - Policy options
  - Maps and tools
  - Design and operations

- Each report is linked and has a short description and key takeaways.
- This is a living document and will continue to be updated.

Large Load Literature Review

July 2025

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Load Forecasting (1)

- **2024 United States Data Center Energy Usage Report (Lawrence Berkeley National Lab (LBNL), December 2024)**
  - The report updates the 2016 estimate of data center electricity consumption and provides future demand scenarios to 2028.
  - The analysis is a "bottom-up" energy use model, calculating total electricity consumption based on data center equipment (e.g., servers, storage, and network equipment) and their associated infrastructure, such as cooling systems.
  - Findings include that U.S. data center annual energy use remained stable between 2014-2016 at around 60 TWh. From 2017 onwards, with the rise of GPU-accelerated servers for AI, electricity use increased, reaching 176 TWh by 2023 (4.4% of total U.S. electricity consumption).
  - Due to the rapid emergence of AI hardware, future energy use is presented as a range (325 to 580 TWh in 2028), accounting for variations in equipment shipments, operational practices, and cooling energy use. This range represents 6.7% to 12.0% of total U.S. electricity consumption forecasted for 2028.

- **Strategic Industries Surging: Driving Up US Power Demand (Grid Strategies, December 2024)**
  - The report provides an overview of load growth and load forecasts in the U.S., noting that in the past two years, the 5-year load growth forecast has increased by almost a factor of five, from 23 GW to 128 GW.
  - The study finds that the primary drivers of this growth are investments in data centers (especially artificial intelligence (AI) and manufacturing, with data centers alone potentially accounting for over 90 GW of future demand.
  - Texas (ERCOT) is noted for the addition of 37 GW to its 2029 forecast, reaching 43 GW total load growth. Other areas driving load growth include PJM, Georgia Power, and the Pacific Northwest.
  - The report emphasizes the critical need for policy changes, such as permitting reform for transmission, and improved load forecasting methods that account for these new, volatile drivers to prevent risks to America's economic, technological, and geopolitical leadership.

Load Forecasting (2)

- **Powering Data Centers: U.S. Energy System and Emissions Impacts of Growing Loads (Electric Power Research Institute (EPRI), October 2024)**
  - This paper presents "what-if" scenarios for future regional load growth projections from data centers, estimates load growth from other sources (manufacturing, electrification, electrolytic hydrogen), and examines how these loads might affect electric sector investments and CO2 emissions under different policy and corporate strategy scenarios.
  - Data center electricity use is higher than previously estimated, accounting for 4% of total U.S. electricity demand in 2023 (doubling from 2017) and projected to reach 5-11% by 2030.
  - The paper further elaborates on scenario inputs and assumptions, and details the changes in capacity and generation across scenarios
  - The report also places special emphasis on data center flexibility, demonstrating that when data center load can be shifted temporally, the average price of power coinciding with data center consumption is reduced.

- **Uncertainty and upward bias are inherent in data center electricity demand projections (London Economics, July 2025)**
  - This report analyzes projections of electricity demand from data centers in the United States, concluding that these projections are highly uncertain and likely overestimated. The authors cite various reasons for this overestimation, such as duplicate requests from data center developers.
  - Report findings include that actual load growth my be weaker than projected due to bottlenecks in equipment for generation and transmission, global chip supply constraints, and potential demand flexibility from data centers.
  - The report concludes that over-forecasting data center growth poses substantial risks for existing utility customers. If new energy infrastructure is built based on speculative projections and the demand does not materialize, the costs would likely be shifted to other ratepayers through higher electricity bills.

Load Forecasting (3)

- **Electricity Demand Growth and Data Centers: A Guide for the Perplexed (Koomey Analytics, Bipartisan Policy Center, February 2025)**
  - This report emphasizes the deep uncertainty in projecting future electricity demand from data centers due to national and regional growth trends, sources of electricity load growth (e.g., manfacturing, data centers) unpredictable AI growth and the potential for efficiency improvements.
  - It cautions against overly aggressive projections and calls for utilities, regulators, and policymakers to base expectations on accurate and updated data and models.

- **Energy Systems Integration Group (ESIG) Large Load Task Force (LLTF)**
  - Large electrical loads, such as data centers, hydrogen production facilities, and EV fleet charging centers, present significant challenges for the electric power industry.
  - To address these challenges, ESIG created a LLTF to unite stakeholders, identify practical solutions, and develop harmonized practices that ensure reliable and efficient grid integration while supporting industry growth.
  - The LLTF has eight project teams, including one focused on load forecasting.

- **Energy and AI: Evaluating Future Grid and Water Stress Due to Data Centers (Pacific Northwest National Laboratory (PNNL), June 2025).**
  - This project focused on two tasks - studying the impacts of data center electricity demand growth scenarios on grid stress in the Western Interconnection in the near term (2025-2035); and studying the grid and water implications of data center demands, siting, and configuration.

Reliability and Resource Adequacy (1)

- North American Electric Reliability Corporation (NERC) Large Loads Task Force (LLTF)
  - The purpose of the Large Loads Task Force (LLTF) is to better understand the reliability impact(s) of emerging large loads such as Data Centers (including crypto and AI), Hydrogen Fuel Plants, etc. and their impact on the bulk power system (BPS).
  - The LLTF will first focus on identifying the unique characteristics and risks associated with emerging large loads, and then validate and prioritize these risks. Following this, the LLTF will identify gaps and mitigation of potential risks to support BPS reliability including enhancements to existing planning and operations processes to help transmission planners and operators mitigate these risks.

- Energy Systems Integration Group (ESIG) LLTF
  - Large electrical loads, such as data centers, hydrogen production facilities, and EV fleet charging centers, present significant challenges for the electric power industry.
  - To address these challenges, ESIG created a LLTF to unite stakeholders, identify practical solutions, and develop harmonized practices that ensure reliable and efficient grid integration while supporting industry growth.
  - The LLTF has eight project teams, including one focused on resource adequacy areas.

Reliability and Resource Adequacy (2)

- Characteristics and Risks of Emerging Large Loads**: Large Loads Task Force White Paper (NERC, July 2025)**
  - Characterizes large loads and defines the reliability risks that they may pose to the BPS.
  - Several Reliability Coordinators and utilities have existing large-load constructs based primarily on facility peak demand. Additional characteristics should be considered in any definition of large loads as peak demand is only one of many characteristics that can impact BPS reliability.
  - The paper offers six recommendations as guidance for future work to ensure the reliability and security of the bulk power sytem.
- Data Center Connectections Workshop: Powering the Data Revolution (AEIC Center for Operational Excellence)
  - Summary report from workshop with participants from utilities, data center developers and industry experts)
  - Workshop explored strategies to integrate data centers into the transmission and distribution system while minimizing grid strain and uploading reliablity, and identified 15 gaps and challenges identified during the workshop.
- Resource Adequacy for State Uility Regulators: Current Practices and Emerging Reforms (NARUC, November 2023)
  - Provides a brief history of resource adequacy; describes federal, regional, state and local regulatory authorieis involved in the resource adequacy process and discusses foundational resource adequacy concepts
  - Explores resource adequacy reforms and supplemental approaches, regulatory considerations for extreme weather and interplay between state resource planning and regional reliability.

Large Load Interconnection

- Practical Guidance and Considerations for Large Load Interconnections **(Elevate and Grid Lab, May 2025)**
  - This report describes large load interconnection process challenges and provides a practical guide to improving and harmonizing utility practices for processing, studying, and assessing large load interconnection requests.
  - It highlights the importance of establishing clear technical interconnection requirements for large loads, drawing lessons from Europe's Demand Connection Code.
  - The report emphasizes that addressing these challenges is crucial for balancing the economic benefits of large loads with the imperative of maintaining grid reliability and fairness to existing ratepayers.
- Energy Systems Integration Group (ESIG) Large Load Task Force (LLTF)
  - Large electrical loads, such as data centers, hydrogen production facilities, and EV fleet charging centers, present significant challenges for the electric power industry.
  - To address these challenges, ESIG created a LLTF to unite stakeholders, identify practical solutions, and develop harmonized practices that ensure reliable and efficient grid integration while supporting industry growth.
  - The LLTF has eight project teams, including one focused on the large load interconnection process, and one focused on large load interconnection requirements.

Demand Flexibility (1)

- Rethinking Load Growth: Assessing the Potential for Integration of Large Flexible Loads in US Power Systems **(Duke University, 2025)**
  - This study presents an analysis of the existing US electrical power system's ability to accommodate new flexible loads.
  - Findings include that 76GW of new load could be integrated if the new load can curtail 0.25% of their maximum uptime; the quantity of new load that could be integrated increases with higher curtailment percentages.
  - It was outside of the report scope to analyze planning considerations such as adequate transmission capacity, ramping capability and ramp-feasible reserves; and assumed that the new loads do not change current demand patterns. This limits the applicability of the results.
- Data Center Flexiblity Initiative (EPRI, no date)
  - Initiative that aims to demonstrate how data centers can support and stabilize the electric grid while improving interconnection and efficiency.
  - Currently there are three workstreams: (1) Grid informed flexibile data center designs, (2) Transformational utility programs and (3) Grid planning for operational flexibility.

Demand Flexibility (2)

- Grid Flexibility Needs and Data Center Characteristics **(EPRI, June 2025)**
  - This whitepaper from EPRI's Data Center Flexible Load Initiative (DCFlex) project explores the concept of flexibility in power systems and how data centers can contribute to it.
  - Presents 4 categories of data center characteristics - size, reliability, workload, and ownership model - which could influence data center flexibility and potential power system impacts
  - Identifies 3 main sources of flexibility within the data center: compute assets, balance of plant, and power assets.

- Turning AI Data Centers into Grid-Interactive Assets: Results from a Field Demonstration in Phoenix, Arizona **(July 2025)**
  - The journal article presents the field demonstration results of a software-only approach to demand flexibility in AI data centers using real-time grid signals.
  - Conducted at a 256-GPU cluster running representative AI workloads within a commercial, hyperscale cloud data center in Phoenix, Arizona, the trial achieved a 25% reduction in cluster power usage for three hours during peak grid events while maintaining AI quality of service (QoS) guarantees.

- DOE Data Center Load Flexiblity Workshop Summary (LBNL, January 2025)
  - Summary report from workshop held in November 2024 with 49 participants representing data center owners, operators, developers, electric utilities, regulators, industry stakeholders and researchers.
  - Key themes are organized responses to four questions posed at the workshop (need for demand flexibility in data centers, opportunities for data centers to be responsive to grid needs, challenges to implementing data center flexibility and opportunities for DOE and national labs to address challenges)

Demand Flexibility (3)

- Center of Expertise for Energy Efficiency in Data Centers **(LBNL)**
  - LBNL's Center of Expertise for Energy Efficiency in Data Centers offers tools, technologies, and analysis to enhance energy performance in data centers.

- Chip-to-Grid (C2G) Data Center Initiative (National Renewable Energy Laboratory (NREL)
  - The C2G initiative is designed to address multiple data center challenges including planning, capacity, security, and energy management.
  - Key goals include maximizing demand flexibility, promoting advanced cooling solutions, optimizing energy use, and improving grid integration through hybrid microgrid power systems.

Generation

- Powering Data Centers with Clean Energy: A Techno-Economic Case Study of Nuclear and Renewable Energy Dependability **(Idaho National Laboratory (INL), June 2024)**
  - This study examines the techno-economic viability of powering data centers with clean energy, specifically comparing nuclear and renewable energy sources.
  - Key findings indicate that fully nuclear-powered configurations outperformed the fully renewable and mixed renewable-nuclear configurations in terms of cost, ranging from $1B to $10B (2023 USD), compared to fully renewable configurations which exceeded $40B.
  - Small modular reactors (SMRs) showed better economic performance than large-scale nuclear models, due to lower projected capital costs, demonstrating the applicability of firm, dispatchable electricity resources from baseload generators like nuclear power plants for operating facilities that run at constant power without daily variability.

- Navigating Economies of Scale and Multiples for Nuclear-Powered Data Centers and Other Applications with High Service Availability Needs **(INL, October 2024)**
  - This paper focuses on assessing the tradeoffs between economies of scale versus mass production to identify promising reactor sizes to meet data center demands.
  - The findings of this study showcase that identifying the optimal size for a reactor is likely more nuanced and dependent on the application and its requirements.
  - Overall, the study shows potential economic promise for coupling nuclear reactors to data centers and industrial heat applications under certain key conditions and assumptions.

Co-Location (1)

- Commissioner-led technical conference regard large loads co-located at generation facilities (FERC)
  - The purpose of the technical conference is to discuss generic issues related to the co-location of large loads at generating facilities.
  - Issues explored at the technical conference included whether co-located loads require the provision of wholesale transmission or ancillary services, related cost allocation issues, and potential resource adequacy, reliability, affordability, market, and customer impacts.

- Accelerating the Integration of New Co-located Generation and Loads **(The Brattle Group, Bloom Energy Corporation, April 2025)**
  - The authors propose an "Energy Park Integration (EPI)" process as a solution to accelerate connection times, reduce transmission upgrades, and alleviate resource adequacy concerns, to address the challenge of integrating new, large electricity loads (like data centers) into the grid, focusing on PJM.
  - The rest of the report outlines the benefits of EPI, and necessary reforms to realize the speed and cost-effectiveness benefits of energy park integration

Co-Location (2)

- Maryland Public Service Commission's (PSC) Report on Co-Location **(Maryland PSC, December 2024)**
  - This report addresses the co-location of end-use electricity customer load with existing or planned electric generation facilities, as mandated by Senate Bill 1 (SB1)/Chapter 537, Section 6, of 2024.
  - The PSC studied potential cost impacts to Maryland ratepayers; potential impacts to wholesale markets (capacity, energy, and ancillary) and planning functions; potential impacts to the reliability of the electric transmission and distribution systems serving Maryland; and provided recommendations to manage or mitigate any of these impacts.
  - The primary focus is on non-Network or "Type B" loads that are "off-system" and exclusively served by co-located generation. The report recommends that relevant authorities clarify the scope of such co-located loads.

- THE CO-LO CONUNDRUM: Protecting Customers in Nuclear-Data Center Colocation **(Wilkinson Barker Knauer LLP, Copper Monarch LLC, September 2024)**
  - This white paper critically examines the growing trend of colocating data centers with existing nuclear power plants. The authors argue that while proponents like the Nuclear Energy Institute (NEI) claim benefits such as "speed to market" and environmental advantages for this model, colocation raises significant public interest and equity concerns, particularly regarding who bears the associated costs and impacts on grid reliability.
  - The authors urge policymakers to investigate these arrangements thoroughly and ensure equitable cost allocation to protect general electricity consumers.

Co-Location (3)

- [How "Power Couples" Can Help the United States Win the Global AI Race] **(RMI, February 2025)**
  - This proposes a strategy called "Power Couples" to rapidly supply clean electricity to data centers, crucial for the growing AI revolution.
  - A Power Couple is defined as the pairing of a large electricity consumer with new-build solar, wind, and battery resources sized to meet the on-site load, all located near an existing generator with an approved interconnection.
  - RMI's analysis suggests that Power Couples at existing gas generators could supply over 50 GW of new load with an average of 88% carbon-free energy for less than $200 per MWh, and over 30 GW for less than $100/MWh.

- **Existing power plants sharing grid access with renewables can lower costs and double US Generation capacity (Grid Lab, 2025)**
  - Using high-resolution satellite imagery, researchers estimated the renewable energy potential within a 6x6-mile buffer zone around existing fossil power plants in the United States (U.S.).
  - Findings include that existing fossil power plants can economically share grid access with around 800 GW of RE currently, and around 1,000 GW by 2030 as the economics of renewable energy improve.
  - Another finder in the paper is that the co-location strategy discussed in the paper can optimize the use of existing infrastructure, helps address the interconnection bottleneck, and generation additional revenue for power plant owners and tax revenue for local communities.
  - Adding RE at the interconnection of existing thermal power plants does not directly increase peak generation capacity in the grid, but by integrating storage with existing RE plants, it can enhance interconnection utilization.

Co-Location (4)

- Redeveloping Coal Power Plants: Data Centers (Pacific Northwest National Laboratory (PNNL), September 2024)
  - This initiative explores the opportunity to repurpose retired coal power plants into sites for data centers, while also potentially integrating clean energy generation
  - Key benefits of this approach include leveraging existing points of interconnection and other infrastructure, and community benefits through job creation, local tax revenues, and direct investment from data center companies.
  - A case study of the Widows Creek coal power plant, which became a Google data center, is provided. The document concludes by outlining the various stakeholders involved in such redevelopment projects, including data center developers, utilities, regulators, clean energy developers, economic development agencies, and local governments, emphasizing the importance of coordination among them.
- **What Happens When A Nuclear Plant And A Data Center Shack Up? (Wilkinson Barker Knauer LLP, Copper Monarch LLC, April 2024)**
  - This white paper examines the increasing trend of data centers co-locating with existing nuclear power plants, particularly within RTO (Regional Transmission Organization) markets.
  - One such reason driving this trend of co-location is the emergence of power purchase agreements (PPAs), which not only offer the seller a higher average price than what the market would deliver, they also provide a certain price to nuclear operators, compared to the volatility of the RTO's wholesale electricity markets.

Co-Location (5)

- The Co-Located Load Solution (Kormos, 2024)
  - Report asserts that in order to bring large data center projects online efficiently and equitably, the electric industry should be focused on finding solutions that best manage reliability, affordability (for all), efficiency, and speed.
  - Authors focus on three aspects of the solution (1) Seperating co-location facts from general concerns about new load, (2) Benefits of co-location and (3) Market re-design to prevent cost shifts.
- **ENERGY PARKS: A New Strategy to Meet Rising Electricity Demand (Energy Innovation Policy & Technology LLC, Energy Systems Integration Group, December 2024)**
  - This study elaborates on the concept of an "energy park", which combines generation assets, complementary resources like storage, and connected customers (co-located loads).
  - It provides an example of the Meitner project, consisting of 400 Megawatts (MW) of hydrogen electrolyzers with 460 MW of on-site wind and 340 megawatts of on-site solar renewable electricity.
  - The study emphasizes that energy park projects like the Meitner project can integrate multiple renewable energy sources, storage solutions like batteries, and potentially co-located electricity consumers such as manufacturing facilities or data centers, all connected to the grid at a single point.

Large Load Tariffs (1)

- Electricity Rate Design for Large Loads: Evolving Practices and Opportunities (Lawrence Berkeley National Lab, 2025)
  - This report reviews ~20 tariffs and identifies characteristics of large load tariffs across different jurisdictions, including opportunities to allocate costs, mitigate ratepayer and utility risk, and attract large loads.
- Review of Large Load Tariffs To Identify Safeguards and Protections for Existing Ratepayers (Energy Futures Group, January 2025)
  - This report analyzes how electricity tariffs and special contracts for large-scale energy consumers (like data centers and cryptocurrency mining operations) can be structured to protect existing ratepayers and environmental goals.
  - According to the report, safeguards should include defined contract terms, tiered load requirements, penalties for poor load/power factors, demand ratchets, clear cost assignment and collateral, interruptible service, and ensuring adequate available capacity backed by the customer or renewable energy.
- Large Load Tariff Design Principles (RMI and Advanced Energy United, no date)
  - This document outlines key considerations for designing tariffs for large-load customers.
  - The principles cover customer eligibility, ensuring participation from diverse large-load customers; fairly allocating costs among customer classes; and recommending tariffs to include price signals to encourage optimal siting, utility operations, and customer behavior for efficiency.

Large Load Tariffs (2)

- [Database of Emerging Large-Load Tariffs (DELTa) (Smart Electric Power Alliance and NC Clean Energy Technology Center, July 2025)]
  - Publicly available database of contemporary utility rates and contracts for large loads.
  - Dataset will be updated quarterly

Policy Options (1)

- **NARUC-NASEO Comprehensive Electricity Planning initiative**
  - Ongoing intiative that builds on the prior Task Force on Comprehensive Electricity System Planning
  - Virtual learning series includes information on load forecasting and planning in an era of load growth
- **NASEO Powering Up data center discussion webinar series**
  - Ongoing discussion series exploring specific strategies State Energy Offices can use to address growing data center electricity demand while supporting energy affordability and grid reliability.
- **Demand Growth & Risk Management: Investing in Energy Infrastructure to Meet Customer Needs (Critical Consumer Issues Forum (CCIF), July 2025)**
  - Outcome of year-long collaboarative process with participation from state commissions, consumer advocates and electric companies resulted in document identifying 13 consensus principles.
  - First eight principles outline a forward thinking framework geared toward addressing challenges and opportunities form rapid electricity demand growth
  - Last five principles focus on risk management pertaining to extreme weather and other catastrophic events and advance recognition of growing financial risks to the electric sector and its customers.

Policy Options (2)

- **Virginia Data Center Study: Electric Infrastructure and Customer Rate Impacts, (Energy+Environmental Economics (E3), December 2024)**
  - This study, prepared for the Virginia Joint Legislative Audit and Review Commission (JLARC) by E3, examines the impact of data center growth on Virginia's electric infrastructure and customer rates.
  - It concludes that data centers are projected to experience an increase in 3-4 cents/kWh by 2040, compared to an estimated increase of 1-3 cents/kWh for residential customers
  - The study proposes various tools to help manage risk and widen the path to equitable integration of data center loads
  - It additionally presents modeling of grid reliability and scenarios pertaining to combinations of energy sources, infrastructure upgrades, and load projections.

- **Texas SB6 Explained: Addressing Large Load Impacts (EPRI, June 2025)**
  - This report provides an overview of the Texas Senate Bill 6 (SB6) addresses the impact of large electric loads (with capacity at least 75 MW), particularly data centers, on the ERCOT-operated Texas grid.
  - Key aspects of SB6 include financial commitments for large loads in the form of interconnection study fee, co-location arrangements, and the introduction of a new reliability service

Policy Options (3)

- **Load Growth: What States are Doing to Accommodate Increasing Electric Demand (Clean Energy State Alliance (CESA), July 2025)**
  - This report surveys and summarizes strategies states are employing to address significant new load growth.
  - The strategies explored include gas generation build out, delaying fossil plant retirements, maintaining clean energy targets, expanding nuclear generation, investing in renewables and storage, energy efficiency, demand response, transmission investments, and limiting ratepayer impacts
  - The report focuses on states seeing the most large load growth.

- **Get a Load of This: Regulatory Solutions to Enable Better Forecasting of Large Loads (RMI, February 2025)**
  - This report addresses the recent surge in electricity demand in the United States after decades of stagnation. It highlights that utilities are expecting a 20% load growth from 2023 to 2035, driven by large new loads like data centers, advanced manufacturing, and electric vehicles.
  - It outlines best practices for improving forecasts, such as employing scenario-based methods, integrating end-use with econometric forecasting, and ensuring consistent use of forecasts across planning processes.
  - Case studies of Dominion Energy (Virginia), Duke Energy (North Carolina), and Georgia Power are presented to illustrate emerging forecasting practices and challenges.

Policy Options (4)

- Optimizing Grid Infrastructure and Proactive Planning to Support Load Growth and Public Policy Goals **(The Brattle Group, July 2025)**
  - The report highlights four key areas for action to address the challenges of rapid load growth in the US power sector: maximizing the value of the existing power system; cost-effectively accelerating new load connections; implementing proactive planning and procurement processes; and introducing targeted affordability measures.
  - The report includes a stakeholder action matrix outlining responsibilities for regulators, utilities, grid operators, governors, legislators, and other actors. It also includes case studies and examples of successful implementations of these solutions in various jurisdictions.

- Proactive Regulatory Approaches to Electrification and Load Growth **(Pacific Northwest National Laboratory, RMI, January 2025)**
  - This report summarizes a workshop which aimed to identify proactive regulatory approaches to manage electrification and load growth while minimizing risks and costs to customers.
  - It proposes both near-term and long-term solutions, along with potential roles for legislators, commissions, utilities, stakeholders, and national organizations like NARUC. These include coordination in planning, enhancing forecasting methodologies, streamlining regulatory processes, better characterizing and leveraging DERs, clarifying funding sources for societal goals, and developing new cost allocation frameworks.
  - The report outlines actions that the Department of Energy (DOE) and national labs can take to support these proactive actions on electrification and load growth These include providing technical training, compiling best practices, convening discussions, and conducting quantitative analysis.

Policy Options (5)

- **US power struggle: How data centre demand is challenging the electricity market model (Wood Mackenzie, June 2025)**
  - This report analyzes the impact of surging data center development on the US electricity market.
  - According to the authors, vertically integrated regulated utilities are best equipped to handle the demand growth due to their integrated planning processes, ability to accelerate project timelines and gain local support, and utilizing existing transmission and fiber infrastructure.

- **Meeting Growing Electricity Demand without Gas: A Brief for Utility Regulators (Energy Innovation Policy & Technology LLC, March 2024)**
  - This brief provides an overview of the growing demand arising from new factories, data centers, and electric vehicles, and elaborates on how utilities are looking to invest in new gas-fired power generation to address this load growth.
  - It is geared towards policymakers, especially the public utility commissioners, urging them to remain skeptical of plans to add new gas.
  - This brief proposes two main solutions: Prioritizing resource efficiency, and leveraging technology and market solutions to bolster resource adequacy.

Policy Options (6)

- **Future-Proof AI Data Centers, Grid Reliability, and Affordable Energy: Recommendations for States (American Council for an Energy-Efficient Economy (ACEEE), April 2025)**
  - This white paper discusses metrics relevant to AI, and policy interventions that are critical to ensuring AI data centers operate efficiently.
  - The authors argue that traditional efficiency metrics like Power Usage Effectiveness (PUE) are insufficient for AI workloads. They propose new metrics, such as energy per AI task and grid-aware computing, to ensure that AI data centers optimize energy consumption across all levels of operation.
  - Policy solutions include grid integration requirements, efficiency targets, transparency requirements, and financial incentives. Collaboration between industry and regulators is key to ensuring best practices, setting efficiency standards, and avoiding unnecessary infrastructure expansion.
- **Load Growth Is Here to Stay, but Are Data Centers? (E3, July 2024)**
  - This paper provides an overview of large load growth and load projections, offers historical context, and proposes innovative ideas for large load developers, power industry planners, and investors to mitigate risks and take advantage of potential opportunities.
  - It provides detailed options that large load Customers, utilities, system planners and regulators can take, along with examples already taking place.

Policy Options (7)

- Assessing the United States' Additional AI Power Capacity by 2030 **(RAND, June 2025)**
  - This report focuses on the additional power capacity needs in the U.S. that will be posed by rapidly increasing electricity demand from AI data centers, considering both front-of-the-meter (FTM) and behind-the-meter (BTM) energy systems.
  - The authors propose a new "available capacity" metric that accounts for project completion uncertainties, effective capacity, and transmission/distribution losses, allowing for direct comparison with future AI data center power needs.
  - Estimate that the available capacity will increase by approximately 82 GW by 2030. FTM additions will add approximately 33 GW of the net available capacity, while BTM additions will increase capacity by 49 GW to reduce grid peak loads.
  - The majority of planned FTM additional capacity is in the ERCOT region, while BTM additions are split among ERCOT, Midcontinent ISO, and non-administrative regions.

- Extracting Profits from the Public: How Utility Ratepayers Are Paying for Big Tech's Power **(Harvard University, March 2025)**
  - The authors argue that the sudden surge in electricity demand from data centers is shifting utilities' focus from societal needs to serving a few energy-intensive consumers.
  - They state that data centers co-located with power plants (co-location) may bypass traditional utility ratemaking and delivery fees, which could lead to increased power market prices and distorted regulated electricity delivery rates for the public.
  - The authors provide several recommendations for state regulators and legislators to protect consumers, such as requiring new data centers to use tariffs instead of one-off special contracts.

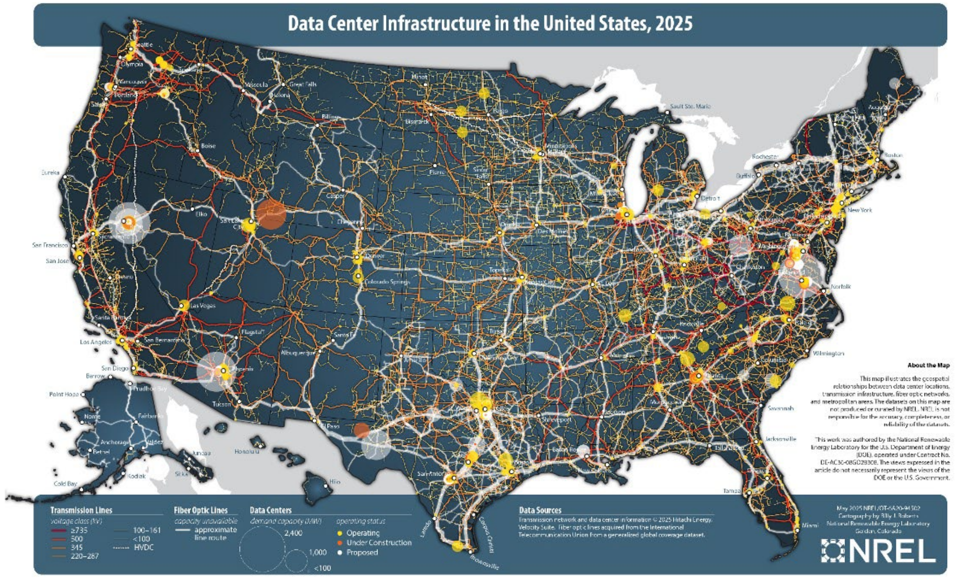
Policy Options (8)

- A State Playbook for Managing Data Center-Driven Load Growth **(Johns Hopkins, June 2025)**
  - Resource for state policymakers to improve understanding of how data centers interact with grid.
  - Provides four levers for policymakers to consider (improving data collection, clarifying utility regulators' ability to tailor rates, establishing substantive requirements for new requests and moratoriums).
- Data Center Impacts in the West **(Western Resource Advocates, July 2025)**
  - Resource for state policymakers to understand energy and water impacts of data centers, with a focus on western states.
  - Provides eight options for policymakers to consider (clean transition tariffs, behind the meter resources, efficiency and load shifting, resource planning and acquisitions, contract provisions, ratemaking best practices, economic development rates and water efficiency and reporting).

Maps (1)

[Data Center Infrastructure in the United States, 2025](#) (NREL, May 2025).

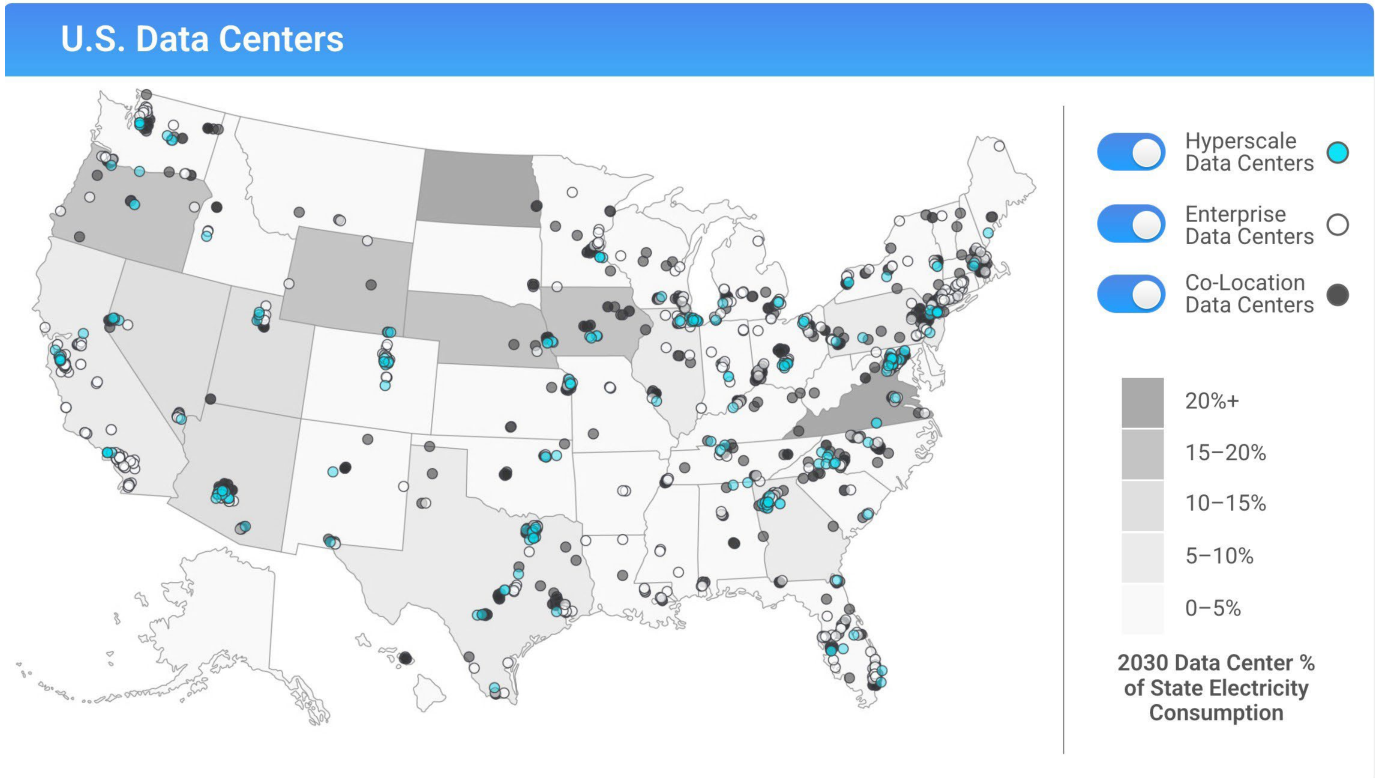
This map illustrates the geospatial relationship between data center locations, transmission infrastructure, fiber optic networks, and metropolitan areas.



Maps (2)

[Interactive Map of Data Centers (EPRI, 2025)]

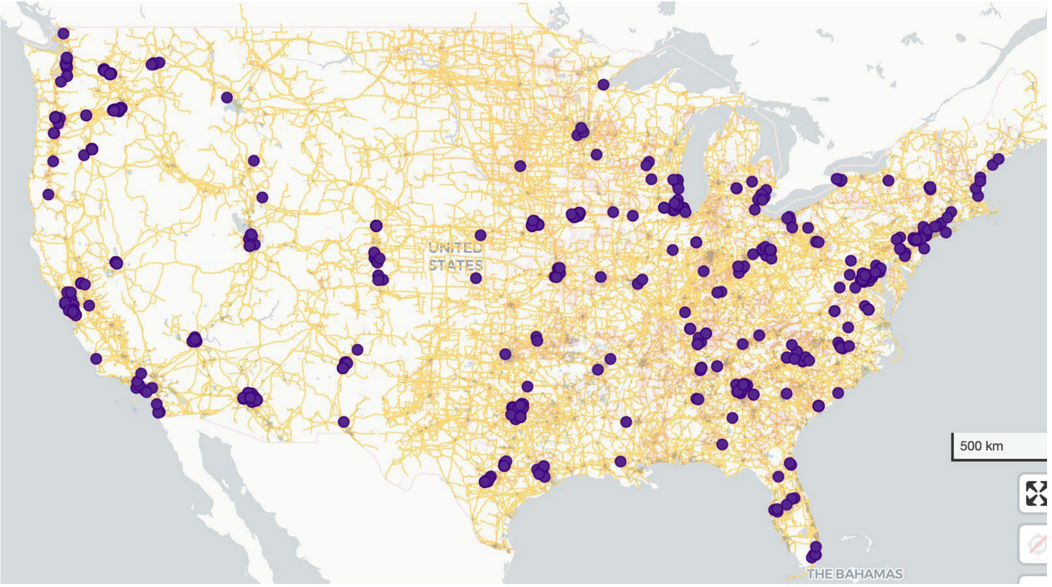
Interactive map on location of data centers and data center percent of electricity consumption.



Maps (3)

IM3 Open Source Data Center Atlas (PNNL, 2025)

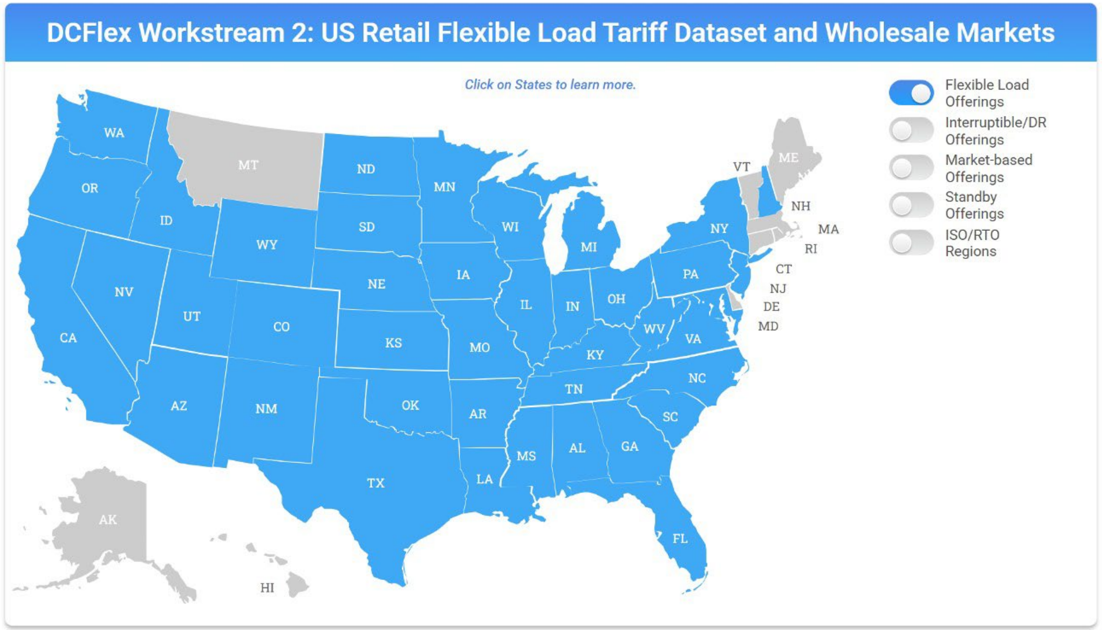
- The IM3 Open Source Data Center Atlas provides locations and facility footprints (when available) of existing data centers across the United States (U.S.).
- Additionally, the dashboard also provides complementary information on electricity infrastructure, municipal water supply, and high-speed fiber availability.



Maps (4)

[Interactive Summary of Flexible Retail Programs and Wholesale Markets](#) (EPRI, 2025)

Interactive map created by EPRI as part of their DC Flex initiative that displays flexible, interruptible, market based and standby programs by state.



Design and Operations

CENTER OF EXPERTISE FOR ENERGY EFFICIENCY IN DATA CENTERS

DOE/LBNL data center program assists organizations with optimizing the design and operation of energy and water systems in data centers.

Assistance	Tools	Key Resources	Training
• Project and technical assistance from the Center of Expertise including identifying and evaluating ECMs, M&V plan review, and project design review • Support optimization of high-performance and enterprise data centers	• Data Center Profiler (DC Pro) Tools (x2) • Air Management Tools (x3) • IT Equipment Tool • Electrical Power Chain Tool • Energy Assessment Worksheets • Data Center Master List of Energy Efficiency Actions	• Best Practices Guide for Energy-Efficient Data Center Design • Center of Expertise Library – filterable list of reports, guides and presentations • Small Data Centers, Big Energy Savings: An Introduction for Owners and Operators	• Data Center Energy Practitioner (DCEP) Trainings • Better Buildings webinar series • On-demand FEMP data center trainings • Center of Expertise Webinars

https://datacenters.lbl.gov/

Additional resources?

If you are aware of other reports that would be useful to include in this literature review, please send the resource to nfrick@lbl.gov.

Thank you

Contact

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