

Aligning IRP and ADR Strategies to Support Sustainable Growth in Data Center Infrastructure

by **Kenneth A. Cottrell, M.A.**

1. Abstract

Data centers are rapidly becoming one of the largest electricity consumers globally due to the exponential growth of artificial intelligence (AI), cloud computing, and digital services. To ensure the sustainable growth of this infrastructure, utilities must modernize their planning strategies by integrating demand-side solutions. This paper explores the alignment of Integrated Resource Planning (IRP) and Automated Demand Response (ADR) strategies as a pathway to optimize energy efficiency, ensure grid reliability, and support the responsible expansion of data centers. By coordinating supply-side and customer-sided resources, utilities and data center developers can create a more flexible, resilient, and sustainable energy ecosystem.

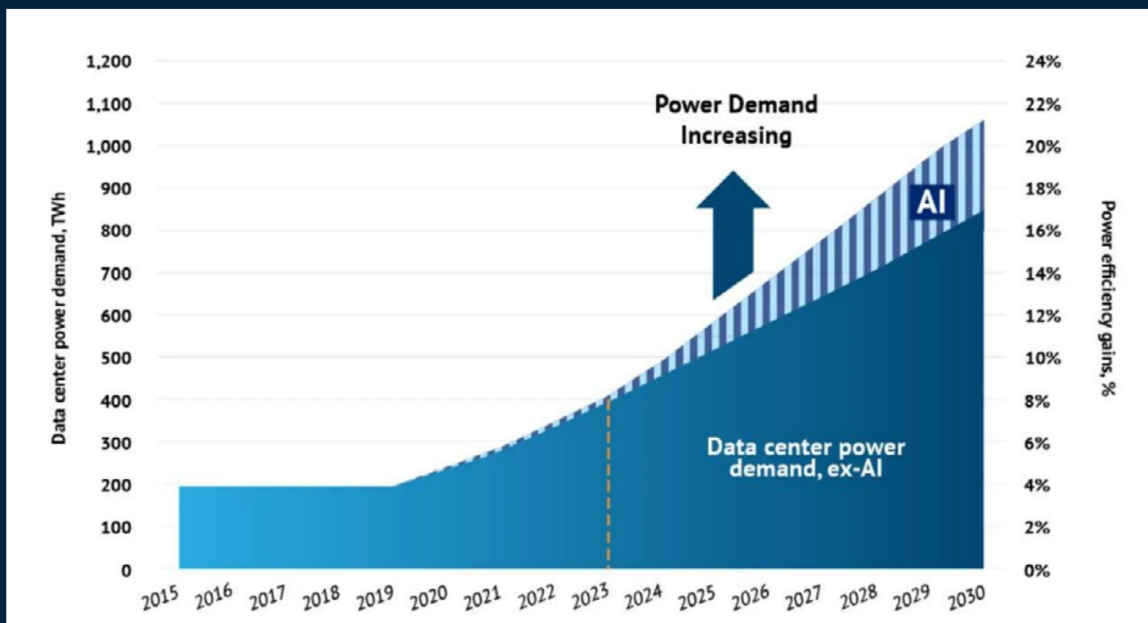


Figure 1. Power demand for data centers.

2. Introduction

The proliferation of data-intensive technologies has driven unprecedented growth in data center construction and energy use. According to the International Energy Agency (2022), data centers account for approximately 1-1.5% of global electricity consumption, a figure expected to rise as demand for cloud services and AI increases. To meet this growing demand sustainably, utilities must adopt modernized planning frameworks that integrate both supply- and demand-side strategies. Two critical mechanisms—Integrated Resource Planning (IRP) and Automated Demand Response (ADR)—can be leveraged in tandem to align infrastructure development with grid reliability and decarbonization goals. This paper examines how aligning IRP and ADR strategies can support the sustainable expansion of data center infrastructure.

3. Integrated Resource Planning and Its Evolving Role

Integrated Resource Planning (IRP) is a regulatory and strategic tool used by electric utilities to forecast future energy needs and determine the optimal mix of generation, transmission, and demand-side resources (Lazar, 2020). Traditionally, IRPs focused primarily on large-scale supply resources such as fossil fuel plants and renewable energy projects. However, the rise of distributed energy resources (DERs), customersided resources (CSRs), and flexible load technologies has prompted a re-evaluation of how IRPs model resource adequacy.

Modern IRPs increasingly incorporate demand-side programs such as energy efficiency, time-of-use pricing, and demand response as integral components of capacity planning. Including these programs helps utilities defer or avoid costly infrastructure investments, enhance grid reliability, and support state and federal climate policies. When IRPs integrate customer-sited technologies such as battery storage, smart inverters, and automated control systems they unlock additional flexibility that is critical for managing rapid load growth associated with large-scale digital infrastructure.

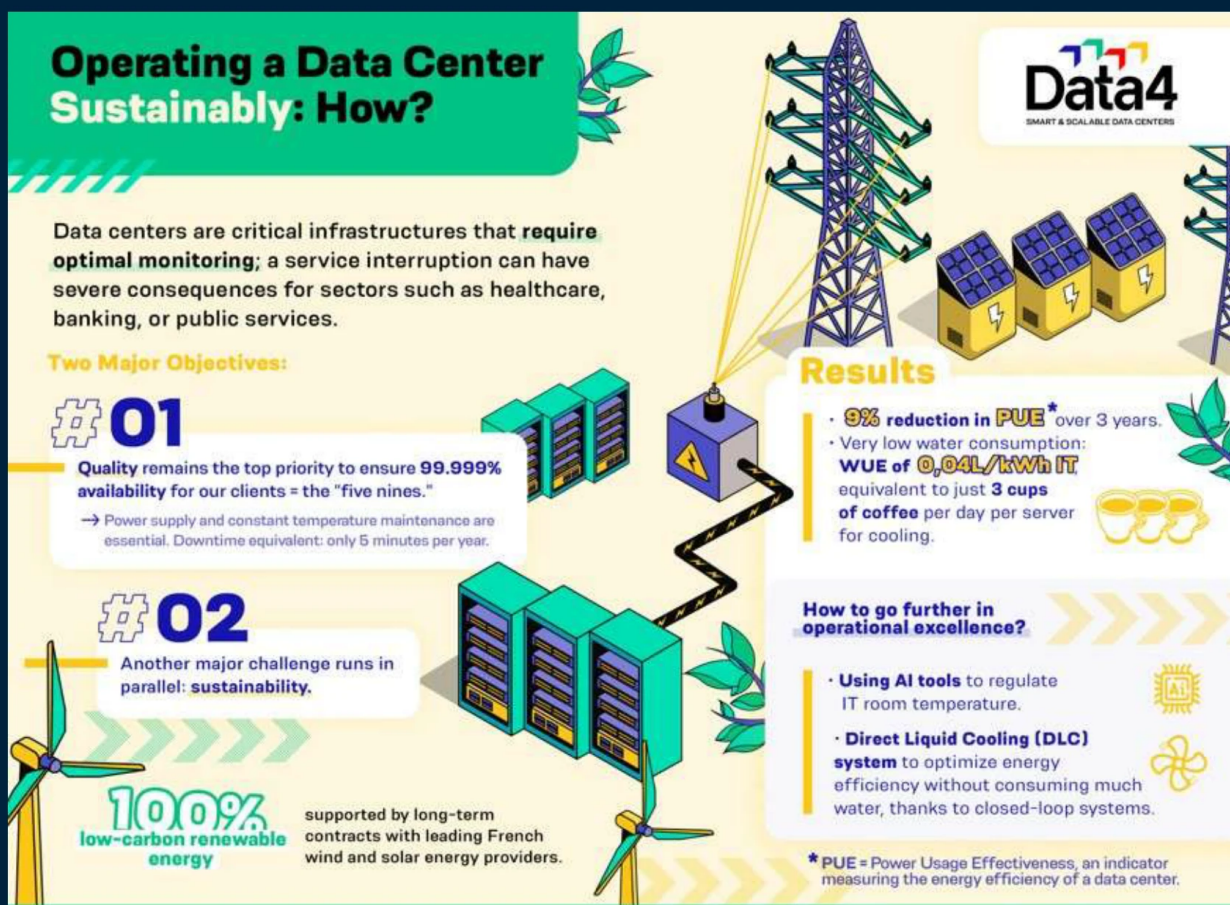


Figure 2. Operating a data center sustainably: How?

4. The Role of Automated Demand Response in Data Centers

Automated Demand Response (ADR) enables large electricity users, such as data centers, to reduce or shift energy consumption in response to real-time grid signals, pricing events, or utility requests. Unlike manual demand response programs, ADR uses intelligent energy management systems to provide fast, reliable load reductions with minimal disruption to operations (Kiliccote et al., 2016).

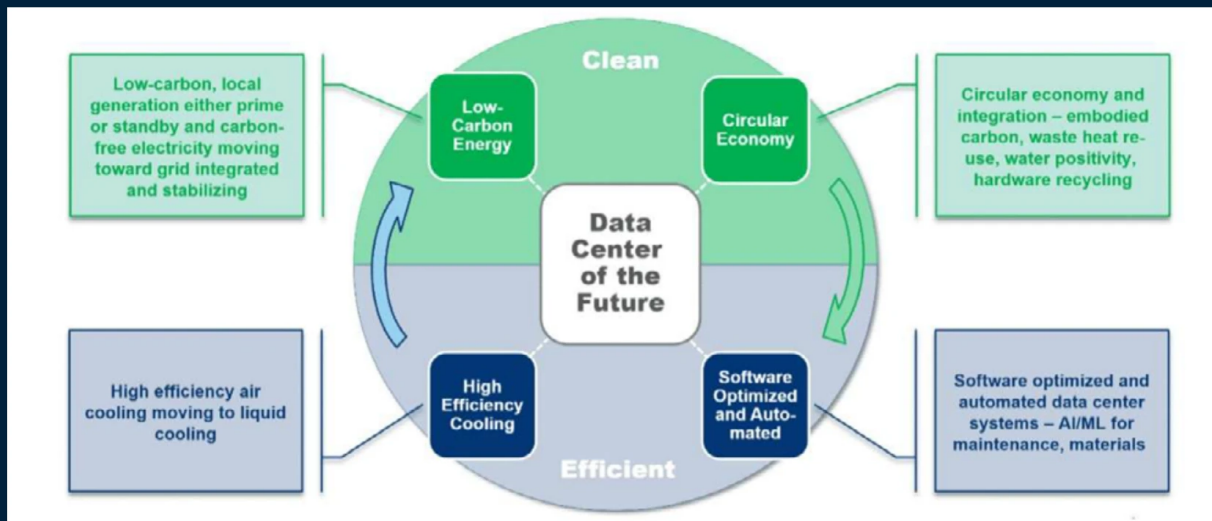


Figure 3. Data center of the future.

Data centers are particularly well-suited to participate in ADR programs due to their sophisticated IT systems, redundant power supplies, and ability to schedule noncritical computing tasks. By adjusting HVAC settings, leveraging on-site energy storage, or curtailing discretionary workloads during peak demand periods, data centers can contribute to grid stability and reduce operational costs. When integrated into ADR programs, these facilities gain financial incentives and demonstrate leadership in sustainability and corporate responsibility.

Furthermore, pre-configuring data centers with OpenADR-compliant technologies during the design and construction phases enables seamless participation in utility demand response programs from day one. This proactive approach reduces barriers to participation and positions data centers as active partners in grid modernization.

5. Strategic Alignment Between IRP and ADR

Aligning IRP and ADR strategies represents a coordinated approach to utility planning and customer engagement. From a planning perspective, utilities can include

ADR participation forecasts in their resource adequacy models, treating demand flexibility as a dispatchable resource. This requires utilities to collect detailed data on potential ADR participants, develop accurate load forecasts, and model the costeffectiveness of load reduction strategies alongside traditional supply options (Satchwell et al., 2021).

On the operational side, integrating ADR into grid operations complements IRP scenarios by enhancing real-time flexibility. For example, in regions with high renewable energy penetration, ADR can help mitigate variability by absorbing excess generation or curtailing load during system imbalances. This capability is especially important for managing the growing energy needs of data centers, which are often located in areas with limited grid capacity or constrained transmission infrastructure.

Utilities and policymakers can further incentivize alignment by offering performance-based rebates for ADR-ready construction, establishing real-time pricing models, and encouraging data-sharing frameworks that enable transparent evaluation of demand-side potential.

6. Conclusion

As the digital economy continues to expand, aligning Integrated Resource Planning and Automated Demand Response strategies is essential for sustainable data center development. By leveraging the flexibility of demand-side resources and incorporating them into long-term utility planning, stakeholders can build a resilient, efficient, and low-carbon energy system. Utilities, regulators, and data center operators must work collaboratively to ensure that energy infrastructure keeps pace with technological innovation while minimizing environmental impact. The integration of IRP and ADR is not only a

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About the Author



Kenneth A. Cottrell, M.A. School of Public Policy and Leadership, University of Nevada – Las Vegas

Kenneth A. Cottrell is a third-year doctoral candidate in Public Policy at the University of Nevada, Las Vegas (UNLV), where his research focuses on implementing energy efficiency programs for indoor agriculture facilities and data centers. His professional and academic journey is marked by a deep commitment to sustainable solutions, social equity, and community engagement.

Driving Energy Efficiency at the Forefront: Recently, Kenneth served as a Project Manager II at Energy Solutions, playing a key role in supporting U.S. Department of Energy appliance standard rulemakings and compliance initiatives. His work involved developing strategies to enhance energy efficiency, stakeholder engagement, and market transformation. With extensive experience in policy analysis and program implementation, Kenneth has successfully contributed to various energy efficiency initiatives at

both federal and state levels. His expertise lies in designing rebate programs, identifying market actors, and developing educational resources to improve compliance and program participation. He has written two articles for the Association of Energy Services Professionals in 2024 about implementing demand response and lighting rebate programs.

Doctoral Research: Implementation of an Automated Demand Response (ADR) program in Nevada for indoor agriculture facilities: Kenneth's doctoral research delves into the implementation of an Automated Demand Response (ADR) program in Nevada, specifically targeted at indoor agriculture. His research explores the complex stakeholder dynamics involved in implementing such a program, including the roles of the Nevada Public Utilities Commission, NV Energy, indoor farmers, technology providers, and other key players. His research aims to illuminate the path towards greater energy efficiency and sustainability within Nevada's burgeoning indoor agriculture sector.

A Leader in Community Engagement: Beyond his professional and academic pursuits, Kenneth is deeply involved in community engagement and mentorship. He serves on the executive board of the 100 Black Men of Las Vegas Inc. and Global Paint for Charity Inc., leading initiatives focused on mentorship, youth development, and sustainable environmental practices.

Education and Expertise

Kenneth holds a Master of Arts in Urban Leadership and a Bachelor of Science in Urban Studies from UNLV, along with studies in Finance at Morehouse College. He is currently a third-year doctoral candidate. His diverse educational background, combined with his professional experience, has equipped him with a unique blend of strategic vision, analytical skills, and leadership capabilities.