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Ares Infrastructure Opportunities

The Convergence of Digital Infrastructure and the Energy Transition

June 2024

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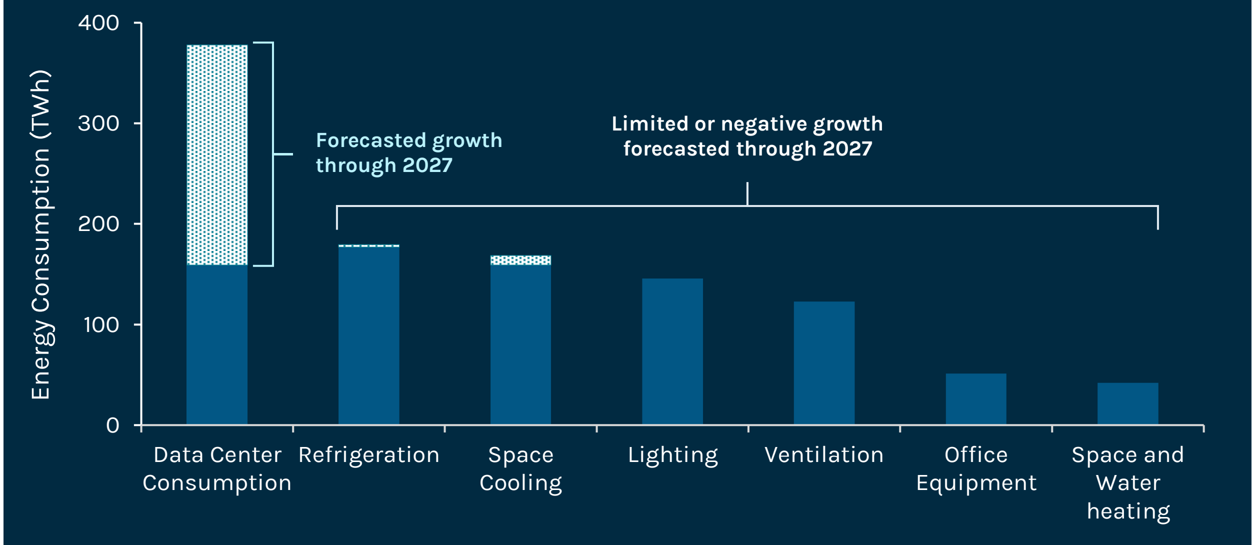
Executive Summary

The acceleration and convergence of two global megatrends - digitization and decarbonization – are driving over $2 trillion in estimated U.S. energy transition infrastructure and data center investment through 2030.[1,2] More specifically, we see that the rapid growth in global data creation, from cloud storage to artificial intelligence ("A.I.") applications, requires new investment into digital infrastructure across data centers, fiber networks, and cell towers. Naturally, this growth is causing a corresponding rise in the demand for power. U.S. data center electricity consumption is expected to reach ~380 TWh by 2027, equivalent to 8.5% of total U.S. electricity consumption and larger than the total electricity consumption of all but 10 countries as of 2021.[3,4]

The robust growth in computing needs and commensurate power requirements have had a profound impact on the power grid, creating load growth while also creating enduring demand for renewable energy. The declining price of renewable energy, supportive policies, and a preference for lower carbon sources of energy have all propelled renewables growth historically. Preference, which is manifested in the form of corporate sustainability ambitions, now appears poised to be a dominant driver of continued renewables expansion. This paper explores the challenges and opportunities that lie ahead at the intersection of digital infrastructure and the energy transition.

Figure 1:
2022 vs. 2027 U.S. Data Center Power Consumption vs. Other Major Commercial Load[5,6]



Key Takeaways

1. **The Rise of Data:** Increased data consumption and processing are causing a reversal of a more than 10-year trend of stagnant U.S. load growth, resulting in a massive boon to renewables deployment.

   U.S. utilities and Regional Transmission Organizations are now forecasting peak electricity demand growth to surge. In some cases, current peak demand growth over the next five years is forecasted at 4.7%, nearly double vs. forecasts of 2.6% just a year prior.[7] This spike in power demand is primarily due to digital infrastructure consumption needs and should support continued investment into new power generation, predominantly in renewables.

2. **The Convergence:** Technology companies that have ambitious climate targets should continue to be a key driver of renewable energy procurement.

   Renewables generation stands to benefit greatly from the convergence of digital infrastructure and energy transition. In the U.S., data-center-related energy consumption procured through power purchase agreements ("PPAs") is expected to increase over 150% from 2023 to 2027.[8] Powering this growth in energy consumption will require an estimated 40-60 GWs of additional renewables generation.[9]

3. **Bridging the Gap:** Power access constraints will drive demand for on-site power solutions, paving the way for more substantial sustainable solutions.

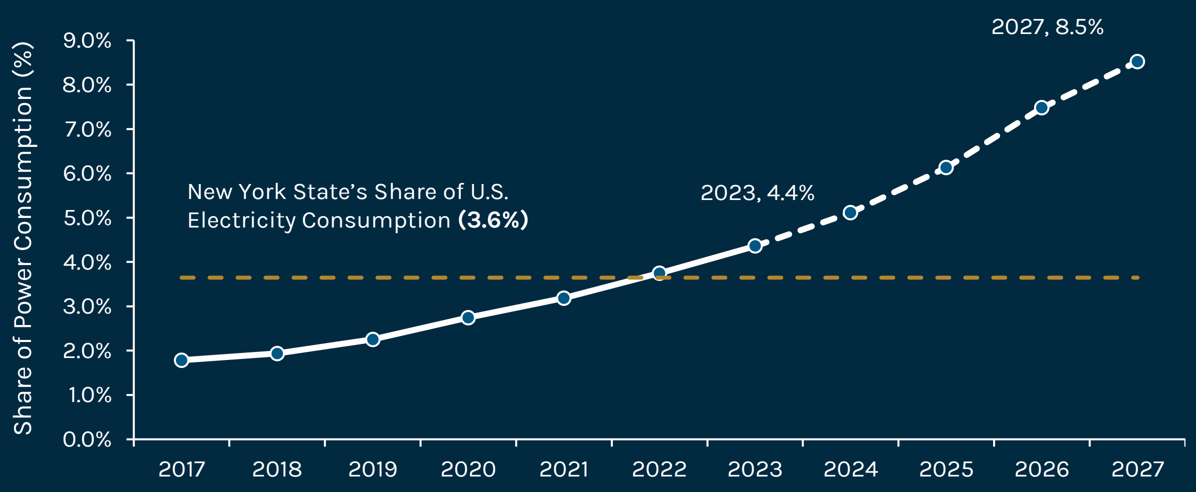
   Data processing growth has been concentrated in select cities, resulting in significant transmission bottlenecks and causing utilities to struggle to offer timely access to reliable power that new data centers require. Bridging solutions, which allow data centers to operate before grid connection is ready, may see increasing adoption. These include the potential of co-locating renewable energy and battery storage with data centers to simultaneously speed access to power and meet the net-zero commitments of large technology companies.

The Rise of Data

Driven by the digitized economy, digital data is now ubiquitous. With the expansion of internet and computing power, most parts of the world have experienced an unprecedented evolution in work, entertainment and social connections. As a result, the demand for faster and higher-quality information and content sharing has led to a surge in data consumption and processing. In the U.S. alone, data traffic has grown from seven zettabytes in 2012 to 101 zettabytes in 2022, with consumption expected to further double to approximately 200 zettabytes by 2026 (one zettabyte is equal to one billion terabytes or 36 million years of HD video).[10] In order to enable this rapid shift, there has been substantial and growing demand for essential infrastructure assets, namely larger data centers supporting increased data processing, denser fiber networks serving as data transmission corridors and expanding networks of cell towers that facilitate wireless transmission of data.

The investment in power generation required to enable the digitized economy is a boon for the power sector. Data processing is an energy intensive activity; data centers alone consumed an estimated 4.4% of total U.S. power generation in 2023, which is greater than the power consumption of the state of New York or the country of Sweden.[11,12,13] Further, 2023 saw the growth in data processing and its accompanying physical infrastructure needs vastly accelerate because of A.I. technology.

Figure 2:
U.S. Data Center Power Consumption as a % of Total U.S. Electricity Consumption[14,15]



As A.I. technologies see broader adoption, U.S. data center electricity consumption is expected to reach ~380 TWh by 2027 and account for 8.5% of total U.S. electricity consumption, which is greater than the electricity consumption of all but 10 countries as of 2021.[16,17] Behind this growth is the expansion in total data center capacity, with the average hyperscale data center - the largest data centers – increasing in size from 6-24 MW today to 50-100 MW for new projects, with 200+ MW projects becoming more common.[18] For comparison, a 200 MW data center campus would consume electricity equivalent to ~114,000 homes.[19]

Figure 3: U.S. Data Center Power Consumption vs. Leading Global Electricity Consumers[20,21]

Rank	Country	Total TWh Consumed (2021)
1	China	8,110
2	United States	3,994
3	India	1,352
4	Russia	1,028
5	Japan	935
6	South Korea	572
7	Brazil	570
8	Canada	534
9	Germany	522
10	France	447
11	U.S. Data Centers in '27	380
12	Saudi Arabia	372
13	Iran	302
14	United Kingdom	297
15	Italy	296

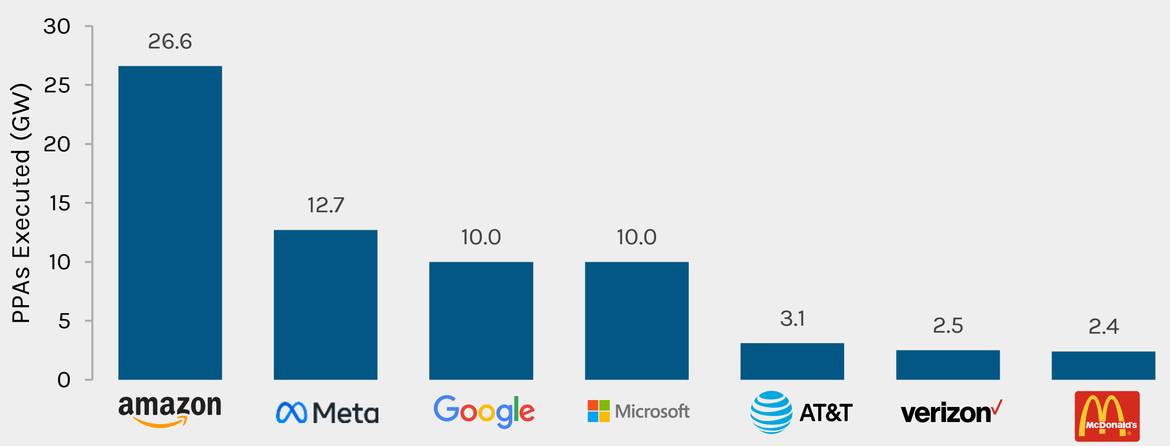
The Convergence

> *"We care about energy for many reasons, but fundamentally it's because our business depends on it... Our data centers – the engines of the Internet that power all of our products and services – run on electricity." – Google*[22]

Corporate Renewable Energy Procurement

Corporations in the U.S. have been a major driver of renewables demand in recent years, representing over 90 GWs of clean energy procurement from 326 different companies since 2008, including 70+ GWs in the last five years alone.[23] Chief among them are the large technology companies, such as Amazon, Meta, Google, and Microsoft, that have ambitious sustainability objectives paired with large and growing power needs associated with their data center operations. To date, virtual PPAs have been the primary pathway for renewable energy procurement. Virtual PPAs are financial instruments that allow a corporation to fix energy costs over the life of a contract (typically 10 to 20 years), thereby reducing exposure to volatile energy prices without taking physical delivery of power. Virtual PPAs also indirectly offset emissions to help achieve clean energy ambitions. Most of the largest technology companies have made 100% renewable energy commitments and some have already reached these goals on an annualized basis (i.e., annual renewable energy purchasing is equal to annual electricity consumption).

Figure 4: Largest Global Corporate Offtakers by GW[24]



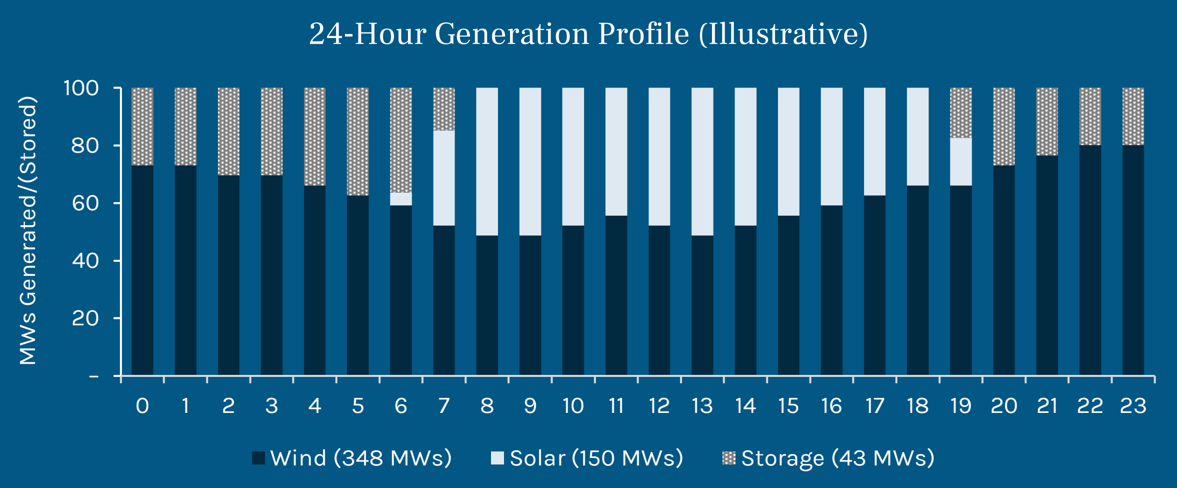
However, due to expectations of significant data center growth and corresponding increases in electricity demand, the goalposts for meeting 100% renewable energy commitments continue to move. Demand for PPAs to offset the energy consumption from data centers is expected to increase over 150% from 2023 to 2027.[25] Powering this additional forecasted data center energy consumption with renewable energy would require an estimated 40-60 GWs of additional renewables generation.[26] Furthermore, many of these offtakers are willing to absorb the recent cost impacts of inflation and supply chain disruption in order to procure renewable energy and meet their sustainability objectives. Continued growth in data processing related power demand should provide developers with sustained pricing power and bolsters existing long-term energy transition tailwinds, enabling continued investment in renewables at attractive development returns and with strong contractual cash flows.

24x7 Renewables

For the most sustainability focused corporate offtakers, achieving 100% annual renewable energy procurement is not enough. Google and Microsoft have been the most prominent in this debate, with a stated goal to operate on 24x7 carbon-free energy by 2030.[27,28] This represents a more challenging standard than offsetting with 100% renewable energy on an annual basis as each hour of electricity consumption must be matched with concurrent renewable energy production. Google and Microsoft, in collaboration with Constellation, AES and LevelTen, announced the creation of the Granular Certificate Trading Alliance in December of 2023 in support of the 24x7 goal.[29] The new initiative will establish a marketplace to facilitate trading of time-based renewable energy certificates such that buyers can achieve carbon-free energy around the clock and energy producers are properly compensated for providing carbon-free energy at times when it is less abundant.

Renewables are not naturally well-suited to providing 24x7 baseload power because power generation is intermittent and tied to solar and wind resource availability. Achieving these 24x7 carbon free goals will require an overbuild of renewables beyond the amount needed to meet annual energy consumption, which places greater emphasis on energy storage deployment to deliver a consistent generation profile. As an example, serving 100 MWs of load with only renewables could require more than 500 MWs of wind, solar and storage. Wind generation will be as important as, if not more important than, solar generation due to the daytime production profile of solar and the need to reliably produce power at all times. Growing corporate adoption of these stringent 24x7 carbon free standards will heighten demand for renewables due to these overbuilding requirements and enhance value for owners of diverse generation technologies.

Figure 5: Illustrative Generation Profile – 541 MW of Renewables to Serve 100 MW of Firm Load[30]



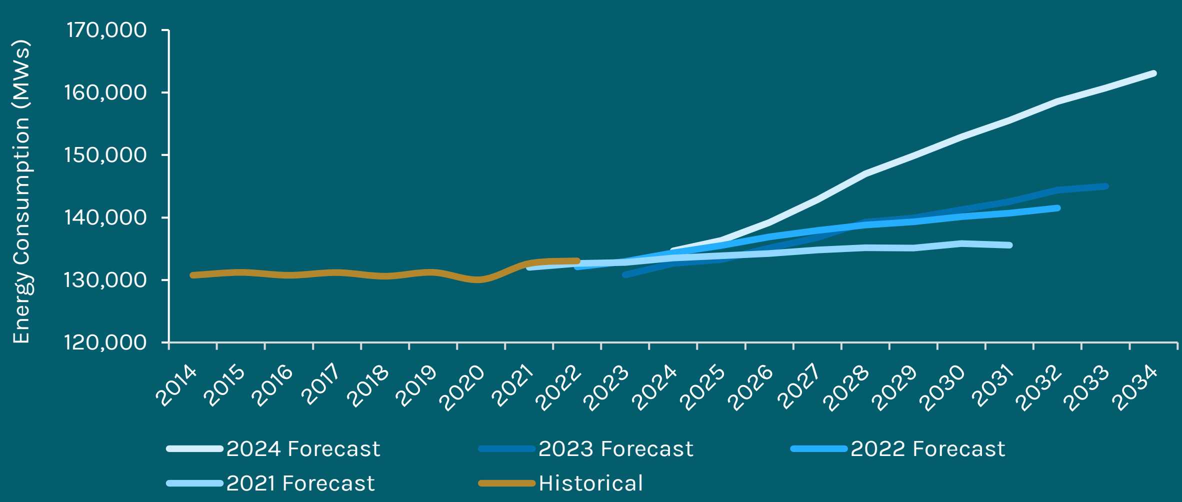
In early March 2024, Amazon surprised the industry by announcing the acquisition of a 960 MW data center paired with a 10+ year offtake agreement for an existing and adjacent 2.5 GW nuclear power plant. Pricing for the offtake agreement suggested a premium of $20-$30/MWh for the 24x7 carbon free attributes, one of the first clear price signals in the market.[31] Developers with expertise across all renewables technologies who can deliver a combined wind, solar and energy storage solution to meet this demand for 24x7 carbon free power should likely capture a comparable premium in offtake pricing due to the inherent challenges of supplying firm carbon-free power.

Bridging the Gap

Data centers require physical access to power. Because virtual PPAs are financial transactions, data centers must still connect to the grid to receive electrons, exposing new projects to grid interconnection delays. After more than a decade of stagnant peak load growth, some utility forecasts are calling for 4.7% peak load growth across the U.S. over the next five years, nearly doubling from previous estimates of 2.6% growth over the period. They cite data center demand as a key driver of that growth.[32] Utilities are already struggling to deliver electricity to data centers primarily due to insufficient transmission infrastructure. Northern Virginia has the world's largest concentration of data centers, totaling 3.2 GW of estimated peak load in 2023 (~19% of summer peak), and is forecast to grow at a compound annual rate of 22% to reach 10 GW by 2030.[33,34] The local utility, Dominion, shocked the data center industry in July 2022 by announcing that it may not be able to deliver requested power until 2025 or 2026 due to the lack of available local transmission capacity. As a result of this increasing data center demand, PJM, the grid operator responsible for much of the Mid-Atlantic and Midwest, has sharply increased its expected load growth forecasts.

PJM Power Demand Forecasts[35]

Figure 6.1: PJM Peak Winter Demand (MWs) – Historical and Forecast



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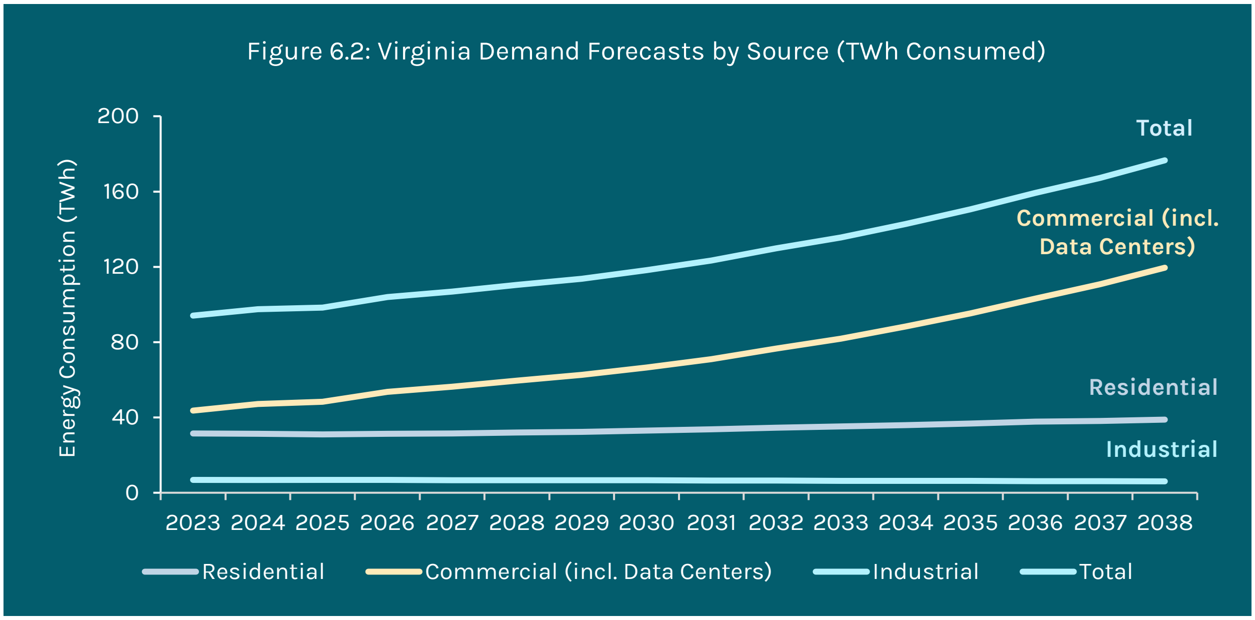


While the challenge in Northern Virginia is particularly acute, it is representative of similar challenges occurring nationwide. Arizona Public Service, the largest utility in Arizona, anticipates it will be out of transmission capacity before the end of the decade due to projected data center growth.[36] Moreover, these transmission challenges are not limited to the U.S.; Ireland's state-owned grid operator announced that it would not interconnect new data centers in Dublin until 2028.[37] In order to bridge the energy gap in the face of these transmission bottlenecks, many data center developers and technology companies have begun to explore bridging solutions that can allow their data centers to operate before grid interconnection is ready.[38]

On-Site Generation and Tailored Solutions

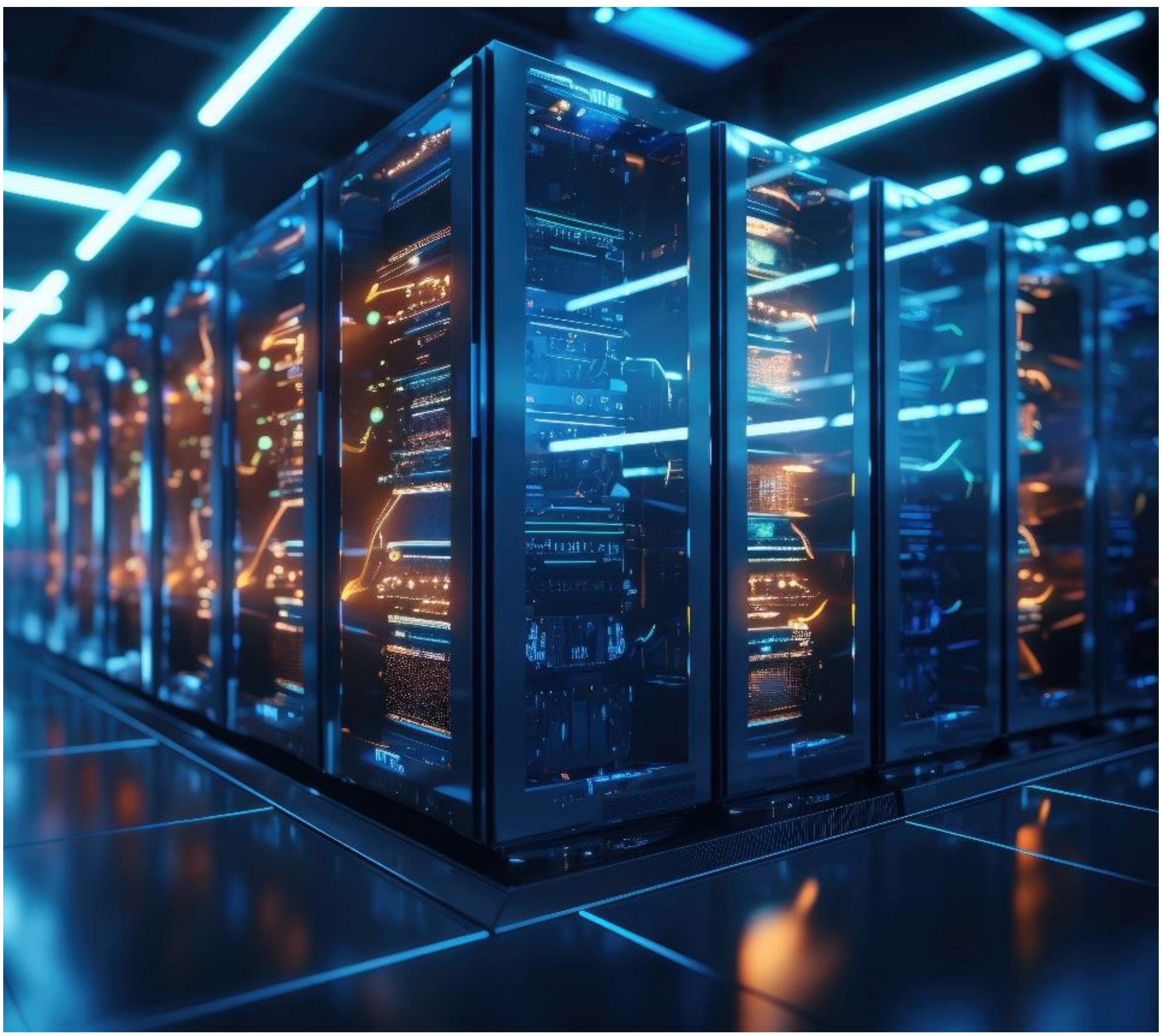
In response to these interconnection bottlenecks, interest has increased in site-specific solutions that provide bridging power until grid-connected utility electricity can be secured. Among these potential solutions are lower-carbon, fuel-based generation. For example, Amazon announced in early 2023 that it would explore powering some of its Oregon data centers with natural gas-powered fuel cells as the primary power source. In addition to greenfield development, well-sited existing gas generation could be re-contracted with a build-out of distribution infrastructure to facilitate a bridging power solution.

These solutions may also eventually provide a longer-term pathway to permanent, net zero generation. From a fueling standpoint, low-carbon fuel solutions could today include renewable natural gas or, as solutions mature, a blending of natural gas with green hydrogen or the installation of carbon capture capabilities. In fact, co-development of data centers and permanent on-site generation can achieve a dual mandate of access to reliable power on a shorter time frame and a quicker path to net-zero emissions operations as opposed to relying on broader grid decarbonization.

Over a longer time horizon, the possibility of onsite power lends itself to the prospect of a tailored, fully packaged solution for hyperscale customers: co-development of on-site, 24x7 zero-carbon power generation alongside a ready-to-lease data center. Co-development opens the possibility of a broader collaboration between renewables developers and data center developers. The final product – a highly desirable green digital data center solution – would be best positioned to secure high-value leases and PPAs and opens the door to broader long-term partnerships.

These tailored solutions may also be more relevant with the coming wave of data center demand and their expected use case. Data centers that support A.I. machine learning model training can be located away from large urban areas with limited impact on performance given minimal latency requirements, whereas traditional, non-A.I. focused data centers are often located nearby users to maximize data transmission speed. As a result, these data centers can be located in areas where land and fiber availability coincide with high wind and solar resources instead of traditional land- and transmission-constrained data center markets, facilitating opportunities for co-development and behind-the-meter power connection. With proper coordination, this may have an added benefit to renewables developers that have also been combating lengthy grid interconnection queues for new generation.

Over time, and bolstered by 24x7 carbon free targets, these new and more complex climate infrastructure investment opportunities will emerge to tackle the challenge of securing access to power in a reasonable timeframe and to take advantage of the greater flexibility of A.I. workloads. Capitalizing on these opportunities to develop creative short-term and long-term green digital solutions will require deep hands-on expertise across project development in renewables, energy storage, transmission, gas-fired generation, and digital infrastructure.



Conclusion

The convergence of decarbonization and digitization represents a generational, multi-trillion dollar opportunity set in U.S. physical infrastructure investment.[39,40] The recent wave of data processing and data center leasing demand coupled with challenges in securing reliable, clean energy for these projects has accelerated and spotlighted this growing convergence. While there are clear near-term obstacles centered around grid constraints, this convergence also represents opportunities for experienced investors with deep expertise across both sectors. The structural growth in power demand propelled by rapidly increasing digitization should incentivize further investment into the power grid for both electricity generation and transmission. We believe understanding the implications of this convergence will be essential for investors to identify and create differentiated opportunities within climate infrastructure.

End Notes

[1] Goldman Sachs. "The US is poised for an energy revolution" (April 2023)
[2] Synergy Research Group, 2023
[3] IDC 2023 Datacenter Deployment and Spend Forecast
[4] EIA. World Electricity Consumption. (March 2024)
[5] EIA, "Annual Energy Outlook 2023", Table 5, March 2023
[6] IDC 2023 Datacenter Deployment and Spend Forecast
[7] Grid Strategies, "The Era of Flat Power Demand is Over" (December 2023)
[8] Proprietary AIO research, based on a survey of 26 industry participants
[9] AIO estimate assuming net capacity factor range of 24-35% for wind and solar assets
[10] Inframation, GSMA, The Mobile Economy (2023), Synergy Research Group (2023)
[11] IDC 2023 Datacenter Deployment and Spend Forecast
[12] U.S. Energy Information Administration, "Electricity Consumption by State" (2022)
[13] EIA. World Electricity Consumption. (March 2024)
[14] IDC 2023 Datacenter Deployment and Spend Forecast
[15] U.S. Energy Information Administration, "Electricity Consumption by State" (2022)
[16] IDC 2023 Datacenter Deployment and Spend Forecast
[17] EIA. World Electricity Consumption. (March 2024)
[18] Altman Solon. Breaking Digital Infrastructure As We Know It. (October 2023)
[19] U.S. Energy Information Administration, "How much electricity does an American home use?" (October 2023)
[20] IDC 2023 Datacenter Deployment and Spend Forecast
[21] EIA. World Electricity Consumption. (March 2024)
[22] Google, "Achieving Our 100% Renewable Energy Purchasing Goal and Going Beyond" (December 2016)
[23] Bloomberg New Energy Finance, "2H 2023 Corporate Market Outlook" (August 2023)
[24] Bloomberg New Energy Finance. (2023)
[25] Proprietary AIO research, based on a survey of 26 industry participants
[26] AIO estimate assuming net capacity factor range of 24-35% for wind and solar assets
[27] Google Data Center Clean Energy, 2023
[28] Microsoft. "Microsoft will be carbon negative by 2030" (January 2020)
[29] LevelTen Energy. "The Granular Certificate Trading Alliance, Led by LevelTen Energy and in Collaboration with AES, Constellation, Google, and Microsoft, Forms to Build a Critical Solution, with ICE, to Decarbonize the Grid" (December 2023)
[30] WoodMackenzie North America Power & Renewables Tool. PJM Dominion July Generation Shape. (March 2024)
[31] Bank of America Research, "Datacenter monetization a blueprint for the sector: Positive merchant nuclear" (March 2024)
[32] Grid Strategies, "The Era of Flat Power Demand is Over" (December 2023)
[33] Aurora Energy Research, "Nodal Price Forecasting and Grid Congestion in PJM" (May 2023)
[34] Virginia Electric and Power Company, "2023 Integrated Resource Plan, Appendix 4H", (May 2023)
[35] JPMorgan Michael Cembalest. "Electravision" (March 2024)
[36] Washington Post. "Amid explosive demand, America is running out of power" (March 2024)
[37] Data Center Dynamics, "Microsoft granted permission to run its Dublin data center on gas" (July 2023)
[38] Data Center Frontier, "The Power Problem: Transmission Issues Slow Data Center Growth" (May 2023)
[39] Goldman Sachs. "The US is poised for an energy revolution" (April 2023)
[40] Synergy Research Group, 2023