Yardeni Research

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Morning Briefing

On Data Centers, Crops & Quantum Computing

Check out the accompanying chart collection.

Executive Summary: There's no doubt that demand for AI is growing. The question is, will new data centers have access to the massive amounts of electricity needed to make AI possible? Jackie takes a look at the electricity logjam down on Earth as well as the potential for data centers among the stars. … Crop prices have had a terrible year, hurt by oversupply and falling exports. Prices could improve if China makes good on its promised purchases and farmers plant fewer acres next year. … Quantum computing may be in AI's shadow, but that doesn't mean progress isn't being made. We take a look at the advancements the industry's giants and upstarts are making.

Information Technology: AI's Low-Tech Problem. With lofty valuations in AI-related stocks, it's understandable that investors are on edge about anything that might go wrong. Recently, concerns have centered on the ability to bring new AI data centers online at the volume AI providers require. While funding for construction is flowing, a lack of electricity and permitting — two very low-tech problems — might be the Achilles' heel of this otherwise high-tech industry.

Demand for AI is growing unabated. On Tuesday, AMD CEO Lisa Su told investors that the company's AI data center revenue should grow by about 80% per year over the next three to five years. As a result, AMD's total revenue is forecast to increase by roughly 35% annually over the same period, which exceeded analysts' estimates.

But AI data center provider CoreWeave threw cold water on any excitement after warning that its Q4 results would miss expectations because a developer failed to deliver data centers on time. Infrastructure that was expected to come online in Q4 will instead come online in Q1-2026 and Q2-2026. The delay didn't cost the company any customers, and demand for space in its data centers is still insatiable, CEO Mike Intrator told CNBC. But the company did reduce its 2025 revenue forecast range to $5.05 billion to $5.15 billion, below analysts' forecast of $5.29 billion.

Microsoft CEO Satya Nadella also recently raised concerns about construction delays. "The biggest issue we are now having is … the ability to get the [data center] builds done fast enough, close to power. So if you can't do that, you may actually have a bunch of chips sitting in inventory that I can't plug in. In fact, that's my problem today. It's not a supply issue

of chips. It's actually the fact that I don't have warm shells to plug into." A "warm shell" is a new data center ready for occupancy.

We wonder if this is the beginning of many problems the industry will face trying to build and deliver data centers on time. Here's a look at some of the numbers surrounding AI data center demand, supply, and electricity:

(1) *A building spree.* Even before AI hit the scene, the number of data centers in the US had been on the rise as more people and businesses increasingly relied on cloud computing to process, analyze, and store their ever-increasing data. The advent of AI pushed that trend into hyperdrive.

Monthly spending on data center construction starts rose to a record $4.2 billion in August, based on a 12-month moving average. That's up 100% from the August 2024 level and 400% from August 2023, ConstructConnect reports. Spending ytd through August at $40 billion had already surpassed the full-year 2024 record (Fig 1). Building has also gotten more expensive, with the average cost per square foot rising to $977 in August, up from $665 a year prior.

The US leads the world in data centers, with 4,189 to date — far exceeding the number in any other country, according to the Data Center Map. The UK has 511 data centers, followed by Germany (487), China (381), France (321), Canada (294), India (276), Australia (275), Japan (247), Italy (209), and others had even fewer—those tracked range from hyperscale data centers to edge data centers.

(2) *A power problem.* US data centers consumed 183 terawatt-hours (TWh) of electricity in 2024, according to IEA estimates cited in a Pew Research Center October 24 report. That works out to more than 4% of the country's total electricity consumption last year. By 2030, consumption is projected to grow by 133% to 426 TWh.

A third of data centers are in Virginia, Texas, and California, Pew reports. Because data centers are often geographically concentrated, they can tax electric grids. For example, about 26% of the total electric supply in Virginia is consumed by data centers.

There are growing concerns that data center demands are driving up electricity prices today and will continue to do so in the future. In recent years, electricity rates have increased as utilities have replaced aging equipment to protect against extreme weather events and cyberattacks. The typical US household was billed $142 a month for electricity last year, up 25% from $114 a month in 2014 (Fig 2). Consumers worried about their electric bills are unlikely to support the construction of new data centers in their communities.

Access to electricity is also causing headaches for those building data centers. Utility connection delays of up to five years are the most significant obstacle for data center growth, reports Bain & Company.

(3) *Looking to the stars.* Currently, data centers receive their energy from traditional electricity sources. Natural gas-powered utilities supplied more than 40% of the electricity used by data centers in 2024. Renewables, like wind and solar power, supplied 24% of the electricity, nuclear about 20%, and coal around 15%, Pew reported.

Going forward, data center companies are looking at traditional sources as well as new ones to augment power supplies. Google Research is exploring space via its Project Suncatcher. The moonshot project is described as placing a constellation of solar-powered satellites carrying Google TPUs into low-earth orbit and connecting them via free-space optical links to create space-based AI infrastructure.

To turn this idea into a reality, Google will need to overcome several challenges, including establishing high-bandwidth communication between the satellites, managing orbital dynamics, and protecting equipment from radiation damage. Placed in the right orbit, a solar panel can be eight times more productive in space than it is on Earth, producing power nearly continuously and reducing the need for batteries.

Google believes that by the mid-2030s, the cost of launching satellites should fall enough to make the cost of launching and operating a space-based data center roughly comparable to the energy costs of a data center on Earth. It plans to launch two prototype satellites by early 2027 to test how its models and TPU hardware operate in space and validate the use of optical intersatellite links for distributed machine learning tasks.

Farm Economy: Looking for a Bottom. US farmers have had a tough 2025 with commodity prices down sharply and costs for everything from fertilizer to insurance up sharply. Adding to the pressure is Trump Tariff Turmoil. The Chinese responded to President Trump's tariffs by ending all purchases of US soybeans, instead increasing purchases from our southern neighbors, Brazil and Argentina.

Farm bankruptcy filings are rising from low levels. In Q1 there were 88 Chapter 12 filings, nearly twice as many as in the same quarter a year earlier. If Q1's filing pace is annualized, full-year 2025's bankruptcies will be far higher than the 216 cases in 2024. Since 2020, the number of farm bankruptcy filings has been much lower than they were in the five years prior.

Why get positive now? Because things were so bad that even incremental pieces of positive news have helped prices. Let's examine what's happening to soybean, corn, and wheat prices.

(1) *Feeling China's influence.* Soybean prices ticked up from depressed levels after President Trump and China President Xi Jinping agreed in principle on a trade deal, under which China would purchase 12 million metric tons of American soybeans during this harvest season and 25 million metric tons a year for the next three years.

Chinese purchases will still be less than the 29 million metric tons of beans it has purchased annually over the past 10 years, but it's a vast improvement from zero purchases this year. After hitting a low of $951.75 in mid-December 2024, the price of soybeans popped to $1,127.25 during November 11, up 11.5% ytd (Fig. 3 and Fig. 4).

(2) *Ethanol saves the day.* Corn prices have also risen off their lows (Fig. 5). Importers took advantage of low prices and picked up their purchases in Q4, and demand from ethanol producers remained strong as well. The US Department of Energy estimates that ethanol

exports are up 36% this year, driven by demand from Canada, India, and Japan. Record amounts of corn were needed to produce that ethanol.

Corn prices didn't surge more because there was a record harvest this year. Some estimates call for lower amounts of corn to be planted in the US next year and in the years to come, which should help prices going forward.

(3) *Wheat continues to lag.* Unlike the other grain prices, wheat prices remain near their recent lows, with production very high in many places around the world (Fig. 6). The International Grains Council now estimates the world's 2025-26 wheat crop is the highest tonnage on record, 819 million, up from 800 million last year. Strong yields more than offset a modest reduction in acreage planted. Consumption rose 2% and equaled output, but larger than normal inventories at exporters weighed on prices.

Disruptive Technologies: Quantum is Growing Up. While most of the market's focus is on artificial intelligence, many companies continue to work on quantum computing in the hopes of creating a computing system that's far more powerful than traditional computers. Among the largest players, IBM, Microsoft, and Google are working to make the technology feasible by the end of the decade.

The government has also recognized the national importance of quantum computing. It's considering taking equity stakes in some of the industry's smaller players in exchange for giving them grants. The stocks of a few of these smaller players have risen by more than 100% this year, leading some to wonder whether the industry is in its own bubble.

Here's an update on the latest news in this exciting industry.

(1) *IBM gives a timeline.* By 2028 or 2029, quantum computers will solve problems that will "surprise and amaze" us, promises IBM's CEO Arvind Krishna. Quantum computers will be able to calculate bond pricing, construct investment portfolios, and forecast corrosion on aircraft wings in real-time and more accurately than traditional computers. Quantum today is where AI and GPUs were in 2015, he told CNBC.

IBM has made progress in improving coherence times, or how long a quantum bit maintains its quantum state. It can currently maintain that state for about 1/10 of a millisecond. When it can maintain that state for a full millisecond, quantum computers will be able to perform calculations that exceed traditional computers' capabilities. IBM is developing smaller, specialized models tailored for specific business applications to run on its quantum computers.

(2) *Google's breakthrough.* Using a new quantum chip dubbed Willow, Google's engineers ran an algorithm 13,000 times faster on its quantum computer than it would run on a traditional supercomputer. "The algorithm in question is called Quantum Echo and models a physics experiment in Nuclear Magnetic Resonance (NMR, the spectroscopic variant of the popular MRI), revealing internal molecular structures by detecting magnetic spins at the center of atoms," Tom's Hardware reported.

The experiment had tongues wagging because it can be reproduced and verified, and because it was a real-use case for quantum computing. IBM and Microsoft have also

introduced chips for the quantum world. IBM recently introduced its Loon and Nighthawk chips, while Microsoft in February introduced Majorana 1.

(3) *The government declares quantum vital.* Several small quantum computing companies are in talks with the US government to exchange federal funding for equity stakes, the WSJ reported. The discussions suggest that the US government views quantum computing as vital to the country's national interests and security.

If successful, quantum computers could potentially crack security codes that are impenetrable to traditional computers and help discover new drugs, materials, and chemicals. National security was also cited when the US government took equity stakes in Intel and rare earth metals producer MP Materials.

IonQ, Rigetti Computing, and D-Wave Quantum are among the companies reportedly in discussion with the government. Quantum stocks have risen sharply this year, including the shares of IonQ (30.3%), Rigetti (105.8), and D-Wave (245.1) (Fig. 7).

Each of the companies recently reported Q3 results that illustrate their youth. D-Wave's Q3 revenue grew to $3.7 million from $1.9 million a year ago, and the company reported an adjusted loss of $18.1 million, versus an adjusted loss of $23.2 million in the year-ago quarter.

Rigetti's Q3 revenue was $1.9 million, down from $2.4 million a year ago. Its operating loss of $20.5 million was up from a $17.3 million loss in Q3-2024. IonQ's Q3 revenue more than tripled from the same period last year to $39.9 million from $12.4 million, but its net loss ballooned to $1.1 billion, and its adjusted EBITDA loss was $48.9 million, up from a loss of $23.7 million in the year-ago quarter.

Before investors get too excited about the government's investment, they might want to wait and see how much equity the government requests in exchange for grants to companies that have yet to turn a profit.

Calendars

US: Thurs: Williams; Daly; Bostic; Kashkari; Musalem; Hammock. **Fri:** Atlanta Fed GDPNow 4.0%; Bostic; Schmid; Logan. (Source: FX Street)

Global: Thurs: Eurozone Industrial Production 0.8%m/m, 2.1%y/y; UK GDP 0.0%m/m, 0.2%q/q; UK Industrial Production -0.1%m/m, -0.2%y/y; Elderson; Greene **Fri:** Eurozone GDP 0.2%m/m,1.3%y/y; France 0.1%m/m,0.9%y/y; Spain Headline & Core CPI 3.1% & 2.5%; Elderson; Lane; Buch; Balz. (Source: FX Street)

Strategy Indicators

S&P 500 Earnings, Revenues, Valuation & Margins (*link*): During the November 6 week, substantially better than expected Q3 results caused the S&P 500's forward revenues to jump 0.7% higher w/w and forward earnings soared 1.6%, both to new record highs and leading the forward profit margin to rise 0.2ppt w/w to a new record high of 14.2%. The forward profit margin is now 3.9ppts above its seven-year low of 10.3% during April 2020. The consensus expectations for forward revenues growth rose 0.2ppt w/w to a 39-month high of 6.6%. From a longer-term perspective, that's well above its 20-year average of 5.2%. It has gained 431ppts from its 33-month low of 2.3% during the February 23, 2023 week. That's down from a pandemic-recovery boosted record-high 9.6% forward revenues growth at the end of May 2021 and compares to 0.2% during April 2020, which was the lowest reading since June 2009. The forward earnings growth forecast rose 0.1ppt w/w to a nine-month high of 13.6%, up 2.7ppts from its 15-month low of 10.9% during the May 29 week. That's a bit stronger than its 20-year average of 11.4%, and is just 0.7 ppts below its 38-month high of 14.3% during the December 12 week. That's also down from its 23.9% reading at the end of April 2021, which was boosted by the recovery from the pandemic to its highest reading since June 2010 and up substantially from its record low of -5.6% at the end of April 2020. Analysts expect revenues to rise 6.2% in 2025 (up 0.1ppt w/w to a new high) and 6.7% in 2026 (up 0.2ppt w/w to a new high), compared to a 5.0% rise in 2024. They expect an earnings gain of 12.5% in 2025 (up 0.5ppt w/w to a nine-month high) and a 14.0% rise in 2025 (up 0.1ppt w/w and near a seven-month high) compared to 2024's earnings gain of 11.6%. Analysts expect the profit margin to rise 0.8ppt y/y to 13.3% in 2025 (up 0.1ppt w/w to an eight-month high) and 0.9ppt y/y in 2026 to 14.2% (unchanged w/w at a seven-month high), compared to 2024's 12.5%. Looking at valuation data as of November 6, the S&P 500's weekly forward P/E fell 0.7pt w/w to 22.6 from a 25-year high of 23.3. That's now up 3.4pts from its 16-month low of 19.2 during the April 17 week. It also compares to 23.1 in early September 2020, which was then its highest level since July 2000, and to a 77-month low of 14.0 in March 2020. The S&P 500 weekly price-to-sales ratio fell 0.07pt w/w to 3.21 from a new record high of 3.28. That's up from a six-month low of 2.22 during the October 26, 2023 week and compares to a 49-month low of 1.65 in March 2020.

S&P 500 Sectors Revenues, Earnings, & Margins (*link*): During the November 7 week, eight of the 11 S&P 500 sectors posted gains in their forward revenues; 10 posted gains in their forward earnings; and the forward profit margin rose for five sectors. These seven sectors had post pandemic- or record-high forward revenues this week: Communication Services, Financials, Health Care, Industrials, Information Technology, Real Estate, and Utilities. Consumer Discretionary is just 0.1% below its record a week earlier and Consumer Staples' would be near a record high too, but is instead 5.0% below due to Drug Retail's exit in late August. Energy's is improving now from its three-year low in May, but remains depressed at 29.0% below its September 2008 record and 16.3% below its cyclical high in October 2022. Materials' is stalling around at two-year high at 4.0% below its June 2022 record high. These six sectors had record-high forward earnings this week: Communication Services, Consumer Discretionary, Financials, Industrials, Information Technology, and Utilities. These three are less than 0.3% from their record highs: Consumer Staples, Health Care, and Real Estate. Forward earnings remains depressed for the last two sectors, Energy and Materials, but have improved in recent months to 39.5% and 20.7% below their respective highs during 2022. Looking at the forward profit margin, five sectors rose w/w and one fell. Consumer Discretionary, Financials, and Information Technology were at record highs. These three sectors remain close: Communication Services, Industrials, and Utilities. Consumer Staples, Energy, Materials, and Real Estate are improving somewhat from their recent multi-year lows, but Health Care's is still at a record low. Here's how the S&P 500 and its 11 sectors rank based on their current forward

profit margin forecasts along with their record highs: Information Technology (28.7%, up 0.3ppt w/w to a record high, its first since September 2024 when low-margin Dell's addition to the index lowered the margin 1.3ppts then to 26.3%), Financials (21.2, up 0.1ppt w/w to a new record high), Communication Services (19.6, down from its 19.8 record high during the August 7 week), Real Estate (16.6, down 0.1ppt w/w to 0.2ppt below its 16.8 eight-month high in early October and down from its 19.2 record high in 2016), Utilities (14.9, up 0.1ppt w/w to a 45-month high and 0.2ppt below its 15.1 record high in April 2021), S&P 500 (14.2, up 0.2 ppt w/w to a new record high), Materials (11.1, steady at a 10-month high and up 0.6ppt from 51-month low 10.5 in late February and down from a 20-month high of 11.6 in July 2023 and a 13.6 record high in June 2022), Consumer Discretionary (9.6, up 0.2ppt w/w to a new record high), Energy (8.7, steady w/w and up from a 55-month low of 8.5 during the during the May 15 week and down from its 12.8 record high in November 2022), Industrials (11.2, up 0.1ppt w/w to 0.1ppt below its 11.3 record high in early January), Health Care (8.1, steady at a record low and down from its 11.5 record high in February 2022), and Consumer Staples (7.1, steady w/w and up 0.4ppt from a 21-month low of 6.7 during the 9/4 week just before Drug Retail's exit from the sector, and down from its 7.7 record high in June 2020).

S&P 500 Q3 Earnings Season Monitor (*link*): With 91% of the S&P 500 companies having reported Q3 results through mid-day Wednesday, the first of the October reporting companies will join the earnings reporting parade after the close. For the 455 reporting companies in aggregate so far, Q3 revenues are ahead of the consensus forecast by 2.3% and earnings have exceeded estimates by a 16-quarter high of 10.4%, down from a 12-quarter high 2.6% for revenues in Q2 and above the 8.2% for earnings. Their revenues have risen 8.0% y/y in Q3 and earnings are up 15.4%, compared to 6.3% and 12.8% in Q2. So far, a 14-quarter high 83% of the 455 companies have higher revenues y/y and a 15-quarter high 73% have higher earnings y/y, up from 81% and 69% rising y/y in Q2. Among the 11 sectors, all have positive y/y revenues growth and all but Energy at -0.6% have higher earnings y/y. Excluding Energy, the S&P 500's y/y revenues growth is 0.6ppt higher at 8.6% and earnings growth improves 0.9ppt to 16.3%.

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