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Spending on AI Is at Epic Levels. Will It Ever Pay Off?

Tech companies pour hundreds of billions into data centers, taking on heavy debt, but current revenue is relatively tiny; echoes of dot-com bubble

By Eliot Brown Follow *and Robbie Whelan* Follow | *Photography by Lewis Ableidinger for WSJ*
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The windswept town of Ellendale, N.D., population 1,100, has two motels, a Dollar General, a Pentecostal Bible college—and a half-built AI factory bigger than 10 Home Depots.

Its more than $15 billion price tag is equivalent to a quarter of the state's annual economic output.

The artificial-intelligence boom has ushered in one of the costliest building sprees in world history. Over the past three years, leading tech firms have committed more toward AI data centers like the one in Ellendale, plus chips and energy, than it cost to build the interstate highway system over four decades, when adjusted for inflation. AI proponents liken the effort to the Industrial Revolution.

A big problem: No one is sure how they will get their investment back—or when.

The building rush is effectively a mega-speculative bet that the technology will rapidly improve, transform the economy and start producing steady profits. "I hope we don't take 50 years," Microsoft CEO Satya Nadella said at a May conference with Meta CEO Mark Zuckerberg, referring to the initially slow adoption of electricity.

"Yeah, well, we're all investing as if it's not going to take 50 years," replied Zuckerberg, who surmised at a recent White House dinner the company's U.S. spending through 2028 was "probably going to be something like" $600 billion.

Main Street in Ellendale, population 1,100.

A pie social in town. For $5, you get a piece of pie, coffee and ice cream.

Silicon Valley watchers worry that enthusiasm for AI has turned into a bubble that has increasingly loud echoes of the mania around the internet's infrastructure build-out in the late 1990s.

Then, telecom companies spent over $100 billion blanketing the country with fiber optic cables on the belief that the internet's growth would be so explosive, most any investment was justified. The result was a massive overbuilding that made telecom the hardest hit sector in the dot-com bust. Industry giants toppled like dominoes, including Global Crossing, WorldCom and 360Networks.

Today, the typically dull world of chips and data centers has become a raging multihundred billion dollar battleground where Silicon Valley giants one up each other with spending commitments—and sci-fi names.

Zuckerberg teased his planned "Hyperion" mega-data center with a social-media post showing it would be the size of a large chunk of Manhattan.

OpenAI's Sam Altman calls his data-center effort "Stargate," a reference to the 1994 movie about an interstellar time-travel portal. Company executives this week laid out plans that would require at least $1 trillion in data-center investment, and Altman recently committed the company to pay Oracle an average of around $60 billion a year for servers in data centers in coming years. Yet OpenAI is on track to take in just $13 billion in revenue from all its paying customers this year.

Six years ago, CoreWeave, the company leasing the North Dakota facility, was an obscure cryptocurrency miner with fewer than two dozen employees. Flooded with money from Wall Street and private-equity investors, it has metamorphosed into a computing goliath with a market value bigger than General Motors or Target.

A view of Main Street.

Today's numbers are far larger than the dot-com bubble, implying a massive shift in the economy would be needed to make these investments worthwhile.

David Cahn, a partner at venture-capital firm Sequoia, estimates that the money invested in AI infrastructure in 2023 and 2024 alone requires consumers and companies to buy roughly $800 billion in AI products over the life of these chips and data centers to produce a good investment return. Analysts believe most AI processors have a useful life of between three and five years.

This week, consultants at Bain & Co. estimated the wave of AI infrastructure spending will require $2 trillion in annual AI revenue by 2030. By comparison, that is more than the combined 2024 revenue of Amazon, Apple, Alphabet, Microsoft, Meta and Nvidia, and more than five times the size of the entire global subscription software market.

Morgan Stanley estimates that last year there was around $45 billion of revenue for AI products. The sector makes money from a combination of subscription fees for chatbots such as ChatGPT and money paid to use these companies' data centers.

How the tech sector will cover the gap is "the trillion dollar question," said Mark Moerdler, an analyst at Bernstein.

Consumers have been quick to use AI, but most are using free versions, Moerdler said. Businesses have been slow to shell out for AI beyond the roughly $30 a month per user for Microsoft's Copilot or similar products. "Someone's got to make money off this," he said.

Predicting when a boom turns into a bubble is notoriously hard. Many inflate for years. Some never pop, and simply stagnate. AI boosters insist that this boom is different from the dot-com era.

Today's tech giants produce far more cash than the fiber builders in the 1990s. And AI is immediately available for use by much of the planet, unlike the internet, which required consumers and businesses to get wired for high-speed access.

OpenAI counts roughly 700 million people—9% of the world's population—as weekly users of ChatGPT as of August, up from 500 million in March, while its revenue is on track to triple over 2024.

If AI continues to advance to the point where it can replace a large swath of white collar jobs, the savings will be more than enough to pay back the investment, backers argue. AI executives predict the technology could add 10% to global GDP in coming years.

"Training AI models is a gigantic multitrillion dollar market," Oracle chairman Larry Ellison told investors this month. The market for companies and consumers using AI daily "will be much, much larger."

The rise of CoreWeave

The financing behind the AI build-out is complex. Debt is layered on at nearly every level.

Alphabet, Microsoft, Amazon, Meta and others create their own AI products, and sometimes sell access to cloud-computing services to companies such as OpenAI that design AI models. The four "hyperscalers" alone are expected to spend nearly $400 billion on capital investments next year, more than the cost of the Apollo space program in today's dollars.

Some build their own data centers, and some rely on third parties to erect the mega-size warehouses tricked out with cooling equipment and power.

Cranes and power lines at the construction site. North Dakota's windy, wintry climate helps keep down cooling costs for the data center.

Then there are middleman companies like CoreWeave, headed by Michael Intrator, a former commodities trader. CoreWeave's main job is to lease data centers, fill them with Nvidia chips and then rent those servers out to tech companies.

The company, headquartered in a drab New Jersey office park next to a Container Store and a waxing salon, ignited investor excitement over AI infrastructure in a big March public offering.

It has had a rapid rise from 2017, when Intrator banded with former colleagues at an energy hedge fund and started Atlantic Crypto, which bought servers to mine the cryptocurrency ether.

The company has a hard driving culture, where executives bark internet slang to inspire the troops such as "YOLO" (you only live once) and "GSD" (get s— done), according to a former employee.

Intrator renamed the firm CoreWeave in 2019 and pivoted to the cloud computing servers that power AI. After ChatGPT's 2022 release sparked the AI mania, he went into overdrive, quickly amassing data centers and chips and signing rental deals with AI companies at a blistering pace. He took on investment from Nvidia, which today holds a stake of more than 6%.

As of this week, CoreWeave has racked up over $42 billion worth of contracts with tech companies renting its servers in coming years, including an expansion of up to $6.5 billion of its previous deal with OpenAI announced Thursday.

That growth was enabled by lots of debt, which Intrator called "the fuel for this company" in a CNBC interview. To finance its chip purchases, CoreWeave turned to Blackstone, its biggest

financing partner, and other lenders eager to jump into the AI space.

Interest rates start above 8% for CoreWeave's financing on its deals with top tech companies including Microsoft, and far more for upstarts. In all, CoreWeave has around $15 billion of debt.

It owes even more to landlords: CoreWeave's securities filings show it is on the hook for $56 billion in payments for leases on data centers, which usually run around 10 years.

Yet CoreWeave's deals with the tech companies are typically for two to five years, according to its IPO filing. That means it will have to make billions of dollars in payments after the tech-company deals expire. It is also carrying the payments on the many data centers where it hasn't yet found a customer to rent the servers.

If the wave of building proves far more than needed, or if tech companies pivot away from third-party providers, the risk is that CoreWeave's data centers could end up like the dormant fiber optic cables that snaked through the U.S. in the 2000s.

Intrator said the data-center boom is akin to the debt-fueled build-out of the U.S. electrical grid early last century, only far bigger—more like a wartime mobilization.

He sees plenty of demand to keep CoreWeave's data centers humming in future years. Intrator has said the company's debt is largely tied to its contracts with the tech companies, which provide more than enough to pay off its loans and its leases. The high financing costs are "the tuition you pay when you build something new, and we paid that tuition to get in early," he said.

"I'm not going to tell you there's no risk," he said. "But we've been incredibly thoughtful about how we've mitigated that risk and structured that debt so that it's appropriate for this technology."

As CoreWeave grows, it is racing to lease data centers going up in energy-rich areas ahead of its rivals. Its reach spans from New Jersey to Texas to Oregon.

The old Farmers Union grain elevator in Ellendale.

Part of the massive cooling system needed for the data center.

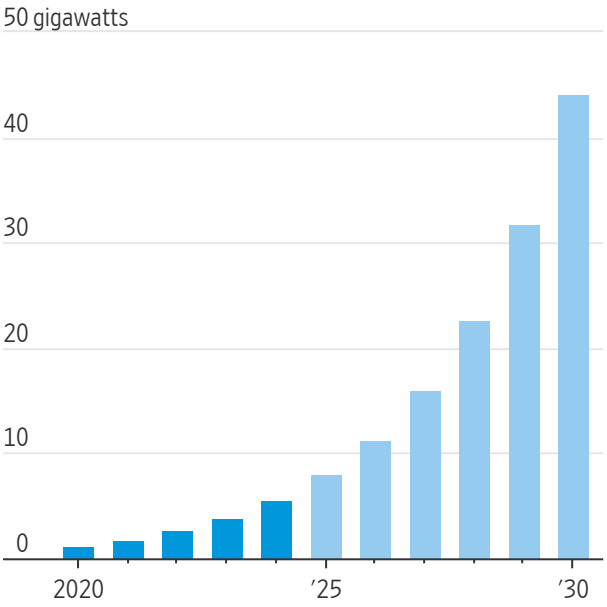
To plant its flag in Ellendale, CoreWeave found a site being developed by data-center builder Applied Digital, which began as a cryptocurrency infrastructure firm before joining the AI rush.

In 2023, Applied Digital started construction on a data center set in gusty plains where wind farms spin cheap energy. North Dakota's wintry climate is a benefit—it costs less to cool down the servers, which draw massive amounts of power and often overheat.

Wes Cummins, Applied Digital's CEO, spent months pursuing tech giants to lease the data center directly without success, pressing on with construction as he took on debt from a Japanese bank and an investment from Macquarie.

He said he grew anxious until earlier this year, when his company and CoreWeave got serious in talks for CoreWeave to lease the data center. In May, they inked the first of three deals. In all, CoreWeave owes Cummins' firm $11 billion over 15 years.

Projected AI data center capacity, North America



Note: 2025-30 are projections
Source: JLL

"CoreWeave is nimble and they move really fast," Cummins said. "They're aggressive, and they stay aggressive," even as the market gyrates.

CoreWeave is slated to install more than $10 billion of chips and other equipment in the warehouselike complex, which is rigged for 400 megawatts of electricity—enough to power over 150,000 homes.

The company has struck deals with two tech companies to use the servers in Ellendale, a spokesman said, declining to name specific users.

Echoes of bubbles past

History is replete with technology bubbles that pop. Optimism over an invention—canals, electricity, railroads—prompts an investor stampede premised on explosive growth. Overbuilding follows, and investors eat giant losses, even when a new technology permeates the economy.

The U.K.'s 19th-century railway mania was so large that over 7% of the country's GDP went toward blanketing the country with rail. Between 1840 and 1852, the railway system nearly quintupled to 7,300 miles of track, but it only produced one-fourth of the revenue builders expected, according to Andrew Odlyzko, an emeritus University of Minnesota mathematics professor who studies bubbles.

He calls the unbridled optimism in manias "collective hallucinations," where investors, society and the press follow herd mentality and stop seeing risks.

He knows from firsthand experience as a researcher at Bell Labs in the 1990s. Then, telecom giants and upstarts raced to speculatively plunge tens of millions of miles of fiber cables into the ground, spending the equivalent of around 1% of U.S. GDP over half a decade.

Backers compared the effort to the highway system, to the advent of electricity and to discovering oil. The prevailing belief at the time, he said, was that internet use was doubling every 100 days. But in reality, for most of the 1990s boom, traffic doubled every year, Odlyzko found.

The town's Opera House, built in 1908 and currently under renovation.

The force of the mania led executives across the industry to focus on hype more than unfavorable news and statistics, pouring money into fiber until the bubble burst.

"There was a strong element of self interest," as companies and executives all stood to benefit financially as long as the boom continued, Odlyzko said. "Cautionary signs are disregarded."

Kevin O'Hara, a co-founder of upstart fiber builder Level 3, said banks and stock investors were throwing money at the company, and executives believed demand would rocket upward for years. Despite worrying signs, executives focused on the promise of more traffic from uses like video streaming and games.

"It was an absolute gold rush," he said. "We were spending about $110 million a week" building out the network.

When reality caught up, Level 3's stock dropped 95%, while giants of the sector went bust. Much of the fiber sat unused for over a decade. Ultimately, the growth of video streaming and other uses in the early 2010s helped soak up much of the oversupply.

Worrying signs

There are growing, worrying signs that the optimism about AI won't pan out.

An MIT report found 95% of organizations surveyed are getting no return on their AI product investments. A University of Chicago economics paper found AI chatbots had "no significant impact on workers' earnings, recorded hours, or wages" at 7,000 Danish workplaces.

OpenAI's release of ChatGPT-5 in August was widely viewed as an incremental improvement, not the game-changing moment many expected. Given the high cost of developing it, the release

fanned concerns that generative AI models are improving at a slower pace than expected.

Each new AI model—ChatGPT-4, ChatGPT-5—costs significantly more than the last to train and release to the world, often three to five times the cost of the previous, say AI executives. That means the payback has to be even higher to justify the spending.

Another hurdle: The chips in the data centers won't be useful forever. Unlike the dot-com boom's fiber cables, the latest AI chips rapidly depreciate in value as technology improves, much like an older model car.

"This is bigger than all the other tech bubbles put together," said Roger McNamee, co-founder of tech investor Silver Lake Partners, who has been critical of some tech giants. "This industry can be as successful as the most successful tech products ever introduced and still not justify the current levels of investment."

New housing being built amid a population increase related to the new data center.

The town took on loans to build new infrastructure and is planning for growth.

Despite the worries, money continues to fly in.

Applied Digital, CoreWeave's landlord in North Dakota, recently broke ground on an additional 280-megawatt data center in the state. It has yet to secure a tenant.

In Ellendale, the population doubles during the daytime as construction workers crowd the sandwich counter at the Cenex gas station during the lunch rush. Once the data center is finished, the permanent population of the town is expected to grow by 300 to 400 people, or roughly one-third.

There's a growing housing shortage, said Mayor Don Flaherty. The town recently took out loans to build sewers, sidewalks and other infrastructure to serve a planned neighborhood of about 20 new houses.

"We're stepping out and taking a chance here, and there's a fear that everything could come crashing down" if the AI boom falters, Flaherty said.

But without the boom, "there's a chance that in 20 or 30 years, Ellendale could be a ghost town," he said. "We're on the wave right now, and we've just got to keep riding it."

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