Emerging tech: carbon capture at source

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13 May 2026

EMERGING TECHNOLOGY SERIES

This report, part of a series on emerging and potentially disruptive technologies that may be deployed in digital infrastructure, Uptime Intelligence assesses the potential for carbon capture to balance carbon budgets.

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Key innovation	**On-site and on-grid gas generation can jeopardize operators' carbon targets. Carbon capture at source of emissions could help to offset the impact.**
Potential impact *(1 is low, 5 is high)*	**2** By integrating new natural gas electricity generation with carbon capture, operators can safeguard net-zero targets that would otherwise be threatened by a reliance on fossil power.
State of maturity	Early adopter.
Main drivers to deployment	Without carbon capture, on-site gas power will delay operators' net-zero targets to 2040 or later.
	Carbon capture technologies are improving.
	The cost of applying carbon capture and storage (CCS) may soon be comparable with energy attribute certificates and offsets.
Main barriers to deployment	Adds 10-30% cost to on-site power generation.
	Needs to be colocated with carbon storage facilities or pipeline.
	Some carbon capture technologies are unproven on electricity generation infrastructure.
Possible date range for wide deployment	2028 (amine systems); 2032 (others)
Key innovators/ companies involved	Turbine makers, e.g., GE Vernova, Caterpillar (solar).
	Energy providers, e.g., NextEra, ExxonMobil, Chevron.
Key companies or type of companies most affected (positively or negatively)	Hyperscalers with net-zero targets (e.g., Microsoft Azure, Google Cloud, AWS).
	Colocation operators that target hyperscalers.
	Energy providers (NextEra, ExxonMobil).

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Context

On-site and grid-connected gas generation will supply a large amount of the power demands of new facilities and campus sites, particularly where grid connections are problematic. However, their carbon emissions may delay operators' net-zero targets to 2040, and beyond.

Natural gas combined cycle (NGCC) turbines and natural gas engines and turbines are available with integrated carbon capture and storage (CCS), offering clean baseload power that can be installed quickly — subject to generator supply chains.

The technology

Commercially available carbon capture technology uses an amine solution to absorb carbon dioxide (CO2) from a gas stream and releases it at high temperatures for storage. Amine solvents are used at coal-fired power stations and some energy intensive manufacturing processes to scrub CO2 from flue gas (which is 15% CO2), which adds $5-40 per megawatt-hour (MWh) of electricity or heat generated. Amine-based CCS can also be used on natural gas turbines that have CO2 flue concentrations of 4-7% with 90% efficiency (see As emissions soar, operators look to carbon capture).

Other carbon capture technologies are being developed (see **Table 1**), some of which may provide cheaper decarbonized electricity. Solid sorbents and chilled ammonia promise lower cost, lower energy debt and good integration with NGCC turbines. These technologies are about 5 years from reaching commercial availability.

Table 1 Carbon capture technologies

Technology	Maturity	CO2 capture efficiency (%)	Integration complexity	Extra energy required (%)	Est. cost of carbon capture ($/MT CO2)	Additional cost per MWh of generated electricity ($/MWh)*
Amine solvents	Commercial	90	Medium	10-30%	$30-90	$5-40
Chilled ammonia process (CAP)	Pilot, demo	90	Medium	20%	$50-65	$30
Solid sorbents (e.g., metal organic frameworks)	Pilot	85	Low	15%	$30-50	$25-30
Calcium looping	Pilot	85	High	30%	$60-100	$25-50
Membrane-based hybrids	R&D, pilot	80	Medium	20%	$45-120	$45-80
Enzyme-enhanced systems	R&D	75	Medium	18%	$40-60	$20-40

**The exact additional cost/MWh depends heavily on the specific plant's design, the degree of heat integration with the existing NGCC plant, and specific operational costs such as water, ammonia, and other consumables. $1/MWh = 0.001 cents/kWh; e.g., $20/MWh = 0.02 cents/kWh*

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Implementations

Some operators in the US are investing in gas-fired power generation with CCS delivered through the grid:

- Google has signed a power purchase agreement (PPA) with the Broadwing 400 MW gas-fired cogeneration and CCS plant in Illinois.
- Meta is helping to fund CCS technology at an Entergy grid power plant in Louisiana.
- Microsoft has publicly expressed willingness to buy CCS power from the grid when the economics improve (see Economics).

Several companies are working on behind-the-meter installations, but these are at an early stage, with few details yet announced. ExxonMobil has indicated plans to build a 1.5 GW natural gas power plant on a data center campus, while Chevron (with US investor Engine No.1) has announced plans to deliver 4 GW of power using GE Vernova turbines with CCS, at sites that include a 1.5 GW campus in West Texas.

Economics

CCS significantly increases electricity generation costs, but the extent of this additional cost varies from project to project. Factors affecting the cost include:

- The cost of energy to operate the CCS systems.
- The capital cost of the CCS system.
- The concentration of CO2 in the flue gas.
- The quantity of energy required to regenerate the capture media.
- Transport and storage of the captured carbon.

Transport and storage costs are estimated to be $5-15 per MWh and will be lowest in regions where carbon can be stored in nearby geological formations, particularly spent oil wells and saline rock formations. In the early stages of adoption, the technology will be limited to regions with these attributes — and may face significant delays while storage sites are being developed and permitted.

Uptime Intelligence estimates that CCS systems will increase electricity costs by 15-40% at $70 per MWh, and by 10-25% at $140 per MWh. Wind and solar systems have lower costs but require batteries or peaking systems to provide baseload power, whereas gas engines and (NGCC and non-NGCC) turbines provide baseload power.

If mitigated natural gas generation has a 20% price premium, it becomes competitive with an unmitigated generation system that applies carbon offsets to achieve net-zero targets. Capturing carbon at the high concentration source makes more technical and economic sense than using biological processes or direct air capture (DAC) systems to capture it at low concentrations from the atmosphere.

Integrated NGCC/CCS plants will take up to 2 years longer to build than standalone NGCC systems. It is likely that many CCS systems will be fitted 2 or 3 years after the NGCC system comes into service.

Commercial activity

Data center operators' highest-profile CCS investments have been mostly in DAC technologies, despite their high costs, immense energy demands and low success rates due to the low concentration of CO2 in the atmosphere (0.04%).

Rising energy prices in 2026 have intensified these issues. Microsoft, which previously accounted for 93% of global carbon removals, paused all purchases of carbon removal credits in early 2026. This has created uncertainty in DAC but point source natural gas generation with CCS continues to attract commercial interest due to its applicability in industry and power generation.

In 2026 so far, $5 billion has been invested in developing all forms of CCS (a 15-fold increase on the rate of investment in 2020), according to the International Energy Agency. In the first quarter of 2026, investors continued cautiously, announcing deals that were mostly smaller than in previous years. Proven applications of CCS, integrated with electricity generation, will be less affected by energy price rises than more energy intensive variants, such as DAC.

Operators seeking to integrate on-site power with carbon capture are advised to partner with specialists to leverage their expertise.

Drivers and barriers

Drivers:

- CO_2 emissions from on-grid and behind-the-meter gas power can delay or endanger operators' net-zero targets.
- Electricity infrastructure providers are offering natural gas generation systems with integrated CCS.
- Additional costs of generating power by NGCC and CCS may become cheaper than carbon offsets.

Barriers:

- Energy prices are increasing due to the energy crisis.
- Carbon capture systems can increase energy consumption by up to 30% for each MWh generated.
- Most CCS systems are not yet widely deployed, and some remain unproven on power generation infrastructure.
- Carbon storage costs are high and may be prohibitive for locations without suitable storage sites.
- There will likely be delays caused by developing and permitting storage sites.

The Uptime Intelligence View

CCS will be deployed at some on-grid and on-site power installations built to support hyperscalers and large colocation data center campus developments over the next 5 years. Its adoption will be geographically limited to areas near developed carbon storage sites — and even those sites may face delays.

Manufacturers and developers of energy systems will need to demonstrate the efficiencies and economics of carbon removal at scale — and develop a broad array of carbon transportation and storage options — to encourage greater CCS adoption.

Operators should consider installing gas engine and turbine systems that are designed for future integration of CCS infrastructure to avoid increasingly expensive carbon offset purchases by those operators committed to achieving net-zero targets.

ABOUT THE AUTHOR

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