BRIEFING DOCUMENT: NATURAL GAS COMBINED CYCLE POWER GENERATION WITH CARBON CAPTURE AND STORAGE

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Background

Natural Gas Combined Cycle (NGCC) is the most efficient form of large-scale electricity generation using natural gas. Despite its high efficiency, NGCC still produces greenhouse gas emissions and modern units (efficiency ~60-64%) emit CO_2 emissions in the order of 330-370 kg CO_2 / MWh.[1] Implementing carbon capture and storage (CCS) with capture rates of 90-95% reduces direct emissions to approximately 20-40 kg CO_2 / MWh.

Market Readiness

CCS on NGCC power generation is a proven technology in the early commercial deployment stage. CO_2 capture technology readiness is high and capture rates over 90% have been demonstrated in various pilot FEED-stage projects.[2] It was also demonstrated at the 40 MW NGCC CO_2 capture project at the Bellingham Energy Center in Massachusetts from 1991-2005. Economics are improving, with OSTI modelling[3] showing CCS on NGCC can be economically viable in key utility regions in the US (ERCOT, PJM), with viability possible in other regions with improved revenue or cost support. In addition, the 45Q tax credit provides additional support for CCS projects in the United States. Historical investments in CCS pilots and demonstration projects have prepared the market for commercial-scale deployment by derisking early projects and helping with the integration of capture projects with shared transport and storage infrastructure.

Although the US hosts over 5,000 miles of CO_2 pipelines,[4] the infrastructure is clustered mostly in the Gulf Coast and Great Plains regions. Across the U.S., applications of NGCC with CCS are most likely to see accelerated interest and deployment in locations where natural gas and CO_2 transport infrastructure already exists, and CO_2 storage sites are already permitted or in advanced stages of permitting.

Market dynamics are a mixed picture. For utility-connected NGCC with CCS, margins on power generation are likely insufficient to cover the additional costs of adding capture, and as such, additional support (e.g., policy) would be necessary for a successful business case. More promisingly, the data center sector is generating enhanced interest in NGCC with CCS as a firm, 100MW+ scale, low-carbon source of electricity that can be developed in pre-2030 timeframes. Global Energy Monitor is tracking a tripling of gas-fired power generation capacity under development in the US in 2025 alone.[5]

Cost implications of CCS

CO_2 capture cost is scale-dependent–larger scale CO_2 streams have a lower cost of capture per metric ton. As such, costs tend to fall into a range depending on the size of the NGCC plant and its associated CO_2 emissions. The flue gas produced from the combusted natural gas is dilute in CO_2, typically in the range of 3-5%[6],[7] by volume. This dilute CO_2 concentration makes it a higher-cost application for CO_2 capture compared to applications with a high-concentration CO_2 flue gas stream such as hydrogen or ethanol production.

[1] Noussan et al. (2024)
[2] Patel (2024)
[3] Pickenpaugh et al. (2023)
[4] Ivory-Moore (2023)
[5] Martos (2026)
[6] Sreenath and Ashish (2025)
[7] NETL (nd)

NETL cost modelling from 2025 indicates that capture costs are in the order of US$96-101 per metric ton of CO_2 avoided.[8] In terms of impact on the cost base of NGCC plants, adding CCS can add in the order of 70-100% to capital cost of an integrated NGCC facility. The energy requirements for the capture plant draw upon steam and power from the NGCC unit, increasing plant operating costs by 30% or more depending on prevailing gas prices. These additional costs are challenging to reach final investment decisions given price sensitivity of businesses and consumers.

On the flip side, NGCC+CCS provides firm, reliable, low emissions electricity that can be developed quickly when located near existing natural gas and CO_2 infrastructure. There is rapidly growing interest in NGCC with CCS for data center developments. The Google and Broadwing Energy NGCC + CCS project in Decatur, Illinois is a positive signal. This project is in development now, planned to supply a Google data center with 400 MW of low carbon power. In addition, Calpine is advancing two NGCC + CCS projects – one in California and another in Texas. In the UK, bp, Equinor, and TotalEnergies, are constructing the Net Zero Teesside Power project, the largest capture project on NGCC to date (732 MW); it is expected to commence operation in 2028.

CO_2 transport involves compression or liquefaction of the CO_2 to transport it by pipeline, ship, truck, or rail. Costs can vary by transport type, volume and distance. For pipelines, the most common transport method, transport costs can vary from USD$0.03 to over $0.10 per km per ton,[9] with lower costs observed above 1 million metric tons per year (the approximate amount produced by a 400 MW facility). Storage involves injecting the CO_2 into deep injection wells, flowing into suitable geological formations that trap the CO_2 indefinitely, sequestering it from the atmosphere. Costs vary considerably by depth, storage geology, and volume of CO_2 to be stored; onshore storage costs are in the US$2-15/ton CO_2 range.[10]

Customer Risks

Customers considering NGCC with CCS will need to manage key risks associated with this technology. There is a risk of delay due to supply chain constraints for gas turbines, and from the interdependencies of sub-projects (capture, transport and storage) that must all be completed for CCS to begin. Given the early phase of commercial deployment of CCS on NGCC, there will be higher first- and second-of-kind risks associated with plant performance, reliability, and capital costs. Costs are expected to decline as more projects come online. Financial risks include the additional capex required for NGCC with CCS, especially compared with unabated NGCC. NGCC systems, with and without CCS, are exposed to natural gas fuel price risk.

Looking into the Future

Given the need for clean, reliable and firm energy options at 100+ MW scale for data center developers, NGCC with CCS can be a well-suited technology for electricity supplies. The costs are comparable or even less than other low carbon-energy alternatives delivering firm power.[11] As early-stage deployments occur, learnings from these projects will drive cost reductions for future projects. The ability to operate these projects entirely “behind the meter” is also a key advantage that will drive growth, as NGCC with CCS does not need to rely on grid infrastructure.

[8] NETL (2025), capture cost only.
[9] Barlow et al. (2025)
[10] Hatta et al. (2025)
[11] Stuckert et al. (2025)