

# **The Potential Role of Natural Gas Power Plants with Carbon Capture and Storage as a Bridge to a Low-Carbon Future**

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Area of research: Carbon Capture, Utilization, and Storage

Natural gas combined-cycle (NGCC) turbines with carbon capture and storage (CCS) are a promising technology for reducing carbon dioxide (CO<sub>2</sub>) emissions in the electric sector. However, the high cost and efficiency penalties associated with CCS, as well as methane leakage from natural gas extraction and distribution, may limit the role of NGCC-CCS to achieve stringent greenhouse gas (GHG) reduction goals. The MARKet ALlocation (MARKAL) energy system optimization model and EPA U.S. nine-region database are used to identify optimal U.S. market penetrations of NGCC-CCS through 2055 in response to alternative GHG reduction trajectories and methane leakage rates. The results indicate that NGCC-CCS is better suited for widespread deployment under a moderate 30% GHG reduction trajectory than under a more stringent 50% trajectory because of upstream methane leakage from gas extraction and the assumption that 15% of CO<sub>2</sub> in exhaust gases with CCS remains uncaptured. Parametric sensitivity runs were conducted for the 50% GHG reduction trajectory, evaluating various fuel, CO<sub>2</sub> capture, and technology parameters. Of the parameters examined, methane leakage rate, NGCC-CCS generating efficiency, CO<sub>2</sub> capture rate, and natural gas price are found to be the strongest factors influencing NGCC-CCS deployment, in that order. Across all 46 sensitivity runs, NGCC serves as a mid-term solution to a low-carbon future and is retrofitted with CCS in the long-term as the modeled GHG trajectories become more stringent. This is an important result as it indicates NGCC may play both a short- and long-term mitigation role, and that CCS retrofitability of NGCC plants and siting near CO<sub>2</sub> storage sites are key considerations. The modeling results suggest that CCS may play a larger role in some regions of the U.S. than others. The West South Central and East North Central regions have the highest electricity generation from NGCC-CCS. The market penetration of NGCC-CCS is shown to have a mixed impact on

air pollutant emissions and energy-related water consumption, depending on the region and which technologies are displaced.