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Deploying gas power with CCS: The role of operational flexibility, merit order and the future energy system

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Abstract Combined cycle gas turbine (CCGT) power plants are an important part of many electricity systems. By fitting them with carbon capture their CO_2 emissions could be virtually eliminated. We evaluate CCGT plants with different variations of post combustion capture using amine solvents, covering a range of options, including solvent storage, partial capture and shifting the energy penalty in time. The analysis is based on the UK electricity system in 2025. The behaviour of individual CCGT plants is governed by the plant's place in the merit order and to a lesser extent by CO_2 reduction targets for the electricity system. In the UK, CCGT plants built from 2016 onwards will emit ~90% of the CO_2 emissions of the whole CCGT fleet in 2025. The typical 'base case' CCGT plant with capture is designed to capture 90% of the CO_2 emissions and to operate dynamically with the power plant. Downsizing the capture facility could be attractive for low-merit plants, *i.e.* plants with high short-run marginal costs. Solvent storage enables electricity generation to be decoupled in time from the energy penalty associated with carbon capture. Beyond a few minutes of solvent storage, substantial tanks would be needed. If solvent storage is to play an important role, it will require definitions of 'capture ready' to be expanded to ensure sufficient land is available

Keywords Carbon capture and storage; Flexibility; Combined cycle gas turbine (CCGT); Power plants; Electricity system; Amine solvents

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