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Underground coal gasification with extended CO_2 utilization as economic and carbon neutral approach to address energy and fertilizer supply shortages in Bangladesh

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The application of underground coal gasification (UCG) with proven carbon mitigation techniques may provide a carbon neutral approach to tackle electricity and fertilizer supply shortages in Bangladesh. UCG facilitates the utilization of deep-seated coal seams, not economically exploitable by conventional coal mining. The high-calorific synthesis gas produced by UCG can be used for e.g. electricity generation or as chemical raw material for hydrogen, methanol and fertilizer production. Kempka et al. (2010) carried out an integrated assessment of UCG operation, demonstrating that about 19 % of the CO_2 produced during UCG may be mitigated by CO_2 utilization in fertilizer production.

In the present study, we investigated an extension of the UCG system by introducing excess CO_2 storage in the gas deposit of the Bahkrabad gas field (40 km east of Dhaka, Bangladesh). This gas field still holds natural gas resources of 12.8 million tons of LNG equivalent, but is close to abandonment due to a low reservoir pressure. Consequently, applying enhanced gas recovery (EGR) by injection of excess carbon dioxide from the coupled UCG-urea process may mitigate carbon emissions and support natural gas production from the Bahkrabad gas field.

To carry out an integrated techno-economic assessment of the coupled system, we adapted the techno-economic UCG-CCS model developed by Nakaten et al. (2014) to consider the urea and EGR processes. Reservoir simulations addressing EGR in the Bakhrabad gas field by utilization of excess carbon dioxide from the UCG process were carried out to account for the induced pressure increase in the reservoir, and thus additional gas recovery potentials.

The Jamalganj coal field in Northwest Bangladesh provides favorable geological and infrastructural conditions for a UCG operation at coal seam depths of 640 m to 1,158 m. Excess CO_2 can be transported via existing pipeline networks to the Bahkrabad gas field (about 300 km distance from the coal deposit) to be injected in the scope of the scheduled EGR operation.

Our techno-economic modeling results considering EGR reservoir simulations demonstrate that an economic and carbon neutral operation of UCG combined with fertilizer production and CCS is feasible. The suggested approach may provide a bridging technology to tackle fertilizer and power supply shortages in Bangladesh, and in addition support further production from depleting natural gas deposits.

References

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