Techno-economic assessment and global sensitivity analysis for biomass-based CO2 capture storage and utilisation (CCSU) technologies

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This paper presents the results of the development and application of the Automated model development suite (MoDS) to biomass based CO2 capture storage and utilization technologies. The first case study focused on techno-economic assessment of biomass based power generation combined with CO2 capture for storage (Biopower CCS) which is widely regarded as a cost-effective high value option persistently features in pathways for rapidly removing large quantities of CO2 from the atmosphere. From the perspective of deployment of Biopower CCS by 2050, ample Biopower CCS technology options involving combustion or gasification of biomass (either dedicated or co-fired with coal) together with pre-, oxy- or post-combustion CO2 capture exist. Twenty eight [1] such Biopower CCS technology combinations were examined and ranked based on various techno-economic assessment criteria and on the models formulated for LHV efficiencies, capital and operating costs (CAPEX and OPEX), and regulated emissions as a function of scale/capacity, co-firing, and the extent of CO2 capture; while covering the critical timescales up to 2050.

In the second case study, MoDS was applied to perform global sensitivity analysis of a CO2 capture and utilization (CCU) process [2,3] that involves the production of algae-derived syngas using a dual fluidized bed (DFB) gasifier. A global sensitivity analysis was performed to determine the impact of key process parameters (i.e. gasification temperature, feed water content, steam to biomass ratio, and fuel-air equivalence ratio) on the product yield and cold gas efficiency. Also, in order to account for different algae strains and varying extents of oil extraction prior to the gasification process the algae oil content was varied from 0 to 40 wt%. The results presented here can help to benchmark gasification against other algae conversion strategies in terms of process efficiency, feasibility and impact on the environment.

References

