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Hydrocarbons with Ultra-Low Carbon Footprint: CCUS and Gasification of Deep Coal Seams

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Abstract

Carbon emissions resulting from the use of conventional underground coal gasification (UCG) technology are comparable to those of conventional coal-based plants. UCG also has a potential of bringing new carbon from its permanent storage in the geosphere into the atmospheric carbon cycle where it will be contributing to global warming. A pathway to address both issues is opened by a fundamental modification of UCG process that incorporates carbon management and CCUS.

Conventional UCG has been transformed by innovative carbon management methods embodied in the εUCG™ technology including four specific in situ techniques: carbon retention, reflux, quenching, and interment. Together they form a novel approach to CCUS in which both compressed and supercritical CO2 are injected into a deep coal seam modified by coal gasification. The coal seam porosity, permeability, adsorption capacity, CO2-storage efficiency factor and other parameters are favorably affected by a transformed gasification process that converts coal to hydrocarbons while leaving in place a large part of its fixed carbon. As we demonstrate, these methods ensure that the overall carbon footprint of the εUCG™ process and end-use plant is demonstrably lower than similar commercial plants using natural gas.

The carbon management techniques, based on a substantial body of experimental and modeling work, are discussed in terms of conceptual design, plant carbon cycle, overall energy and carbon efficiency of the process, and the capital and operational cost.

Two examples of the εUCG™ applications for power generation, methanol synthesis, and biotechnology include the Cvictus Inc project in Alberta, Canada and the Tata Steel project in India. These projects are discussed in salient technical, environmental and economic details.

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