

Renewable energy supply and carbon capture: capturing all the carbon dioxide at zero cost

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Abstract

Climate change is likely to be (and is) more serious and likely to proceed much more rapidly than was previously thought. This article surveys and evaluates the technology of processing carbon dioxide and hydrogen into sustainable synthetic carbohydrate fuels and the related economics in relation to a particular route, the capture of carbon dioxide from the flue gas stream of gas burning power stations, provided the gaseous fuel is of biogenic origin. Biogenic methane is renewable and can, after combustion into carbon dioxide, via carbon capture be further processed into a range of carbohydrate fuels, or alternatively captured for final storage under CCS. It is proposed that the air intake of a power station be replaced by cooled flue gases consisting mainly of carbon dioxide, enriched with oxygen obtained by electrolysis of water. The co-produced hydrogen can then be processed further into more easily transportable and storable forms of fuel. This implies that a gas fired power station is not so much a means of producing energy, but rather of producing pure carbon dioxide.

The capture process as such is the same as the one which arises if the purpose is CCU (Carbon Capture and Use) or CCS (Carbon Capture and Store) in which case capture of CO₂ from the combustion of methane from biogenic origin amounts to negative emissions. The indirect route of supplying and using energy via the production of carbohydrate fuels requires much more primary energy than the direct use of electricity does. For this reason, use of that indirect route is efficient for aviation, where the direct route of electric power is impractical. For shipping, there also is the alternative of the implicit transport of hydrogen as part of ammonia. It is assumed that the use of biogenic methane followed by processing of the captured carbon dioxide into synthetic hydrocarbon fuels is in combination with volcanic carbon hydroxide, sufficient to meet the demand for hydrocarbon fuels. Capture of carbon dioxide from biogenic methane can also be applied in the context of CCS.

Keywords: synthetic carbohydrate fuels, energy efficiency, CCS, ammonia.