Carbon recovery and re-utilization (CRR) from the exhaust of a solid oxide fuel cell (SOFC): Analysis through a proof-of-concept

Abstract:
In the context of the paradigm of Carbon Recovery and Re-utilization (or CRR), this work investigates the role of electrochemical generators (such as high-temperature fuel cells) to perform CRR as a practical secondary effect. In fact, the solid oxide fuel cell (SOFC) operating principle is inherently beneficial toward CO2 separation from the exhaust gas since the fuel is electrochemically oxidized resulting in no N2 mixing at the anode (fuel) electrode. An oxy-combustor downstream the fuel cell will complete the residual fuel (mostly H2 and CO) oxidation to yield a stream that contains only H2O and CO2. After water condensation and further drying, the captured CO2 is fed to a photobioreactor that can fix carbon into microalgae. In this work, results of the first SOFC-based poly-generation system with complete CO2 recovery in the form of fast-growing biomass (micro-algae) are presented, as developed in the EU-funded project SOFCOM (GA 278798, www.sofcom.eu). The overall plant layout is described, and results on the performance of the proof-of-concept plant units are provided.