Rechargeable Thermochemical Energy Battery for Energy Storage from Renewable Sources (ReThebes)

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The energy world scenario is abruptly changing mainly due to the increasing share of the renewable energy sources like wind, solar and biomass. Solutions to mitigate the intrinsic fluctuations related to green power production, and to accomplish the requirements of seasonal and long-duration energy storage, are needed. One is represented by Thermo-Chemical Energy Storage (TCES), based on thermochemical cycles of solid materials which undergo a reversible reaction.

The aim of ReThebes project is the development of a thermochemical battery. The system is based on a Directly Irradiated Fluidized Bed Autothermal Reactor (DIFBAR) operated as: i) a calciner (starting from $CaCO_3$) with thermal input coming from renewable sources and a CaO storage vessel during the charge phase; ii) a carbonator (of CaO) and storage vessel of spent sorbent during the discharge phase. The demonstration of DIFBAR proof-of-concept as a thermochemical battery could represent a breakthrough step for the development of TCES systems. The development of innovative state-of-art materials is also crucial for the thermochemical battery performance. The study of these aspects provides the input for the simulation of the entire process and for its scale-up for on-sun testing at pilot scale. The main project goals are: i) Best performance of DIFBAR as thermochemical battery in the charge/discharge cycle; ii) Development of state-of-art materials for energy and CO_2 storage; iii) Process simulation of the rechargeable battery based on DIFBAR proof-of-concept coupled with the CO_2 capture system; iv) Criteria of scale-up of DIFBAR as thermochemical battery; v) Basic and detailed design of DIFBAR as thermochemical battery at pilot scale with an energy storage capacity and time of about 1 kWh and more than 8 h, respectively.