# Cost-Optimized Solar Gas Turbine Cycles using

# Volumetric Air Receiver Technology

**P. Schwarzbözl*, R. Pitz-Paal*, W. Meinecke*, R. Buck****

*Solare Energietechnik, Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR), Linder Höhe, 51170 Köln, Germany

Tel.:+49 2203 601 2967, Fax:+49 2203 66900, e-mail: peter.schwarzboezl@dlr.de

**Institut für Technische Thermodynamik, Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR)

Pfaffenwaldring 38-40, 70569 Stuttgart, Germany

*Abstract*

Hybrid solar-fossil power plants are assessed today to have good chances for rapid market penetration of solar concentrating technology as they reduce investors' risks by extending the full load operation hours. Especially, concepts using modern gas turbine and combined cycle technology seem favorable due to their high energy conversion efficiencies. Here, the concept of solar air preheating for recuperated or combined gas turbine cycles is analyzed. In these systems combustion air is heated in a pressurized volumetric receiver before entering the combustion chamber using central receiver technology. Units of volumetric receiver modules with secondary concentrators are clustered to reach the desired power level. The solar contribution to the gas turbine thermal power input depends on the receiver temperature and hence on absorber materials. Current developments of absorbers with multi layers of metal wire screens allow receiver design temperatures of about 800°C.

Several configurations of solar-fossil gas turbine cycles in the low to medium power range are examined. Software tools were developed and enhanced allowing the search for cost-optimized heliostat field arrangements and layout of tower and receiver components. Detailed transient simulation of total plant operation is performed with real site radiation and environmental data leading to reliable estimates of the annual energy yield. These are the basis for preliminary energy cost calculations. The results show a promising potential of this technology to reach competitiveness in certain power markets: For a small 4 MW recuperative cycle, total plant installation costs of about 1300 US$/kW are estimated. Operation at a high insolation site (2400 kWh/m_ a) with 4000 full load hours leads to an annual solar share of 23% and LEC of about 9 US¢/kWh. Aim points of future developments for system improvement and cost reduction are presented.