In this paper we present the simulation of a concentrating PV-thermal (CPV-T) linear Fresnel collector receiver, which includes the full optical, thermodynamical and electrical modelling. In the second part, the prototype construction and its construction and evaluation are described. In previous work we described the CPV-T receiver concept and first simulation results in Ansys Fluent [1]. Subsequent work describes the thermodynamic modelling of the receiver and the optimization of the receiver based on modelling results [2]. Based on this work, the optical modelling of the linear Fresnel collector is added, and detailed loss mechanisms in the thermal simulation, which were neglected in previous work, have been added.

For the validation of the simulation tool a prototype receiver was developed and evaluated. Construction and testing was performed at the University of Lleida, Spain, due to better direct solar irradiance conditions.

Characterization of the receiver was carried out by applying different concentration ratios. An overall system efficiency of more than 55% could be achieved. The bulk of the energy output was thermal energy. Investigations showed that when applying the concept of spectral splitting with fluid channels in front of the photovoltaic cells the electrical energy yield decreases only marginally. For the validation of the simulation tool, several measurement data sets were examined. The initial conditions, in particular the irradiation, served as input parameters for the simulation.

The comparison between the simulation tool of the hybrid receiver and the prototype is realized for six different measuring points. In one of the measurements the thermal efficiency is 69%, that of the simulation is 73%. The measured electrical efficiency is 5.1%, showing good accordance of the simulation model and measurements.

Based on the validation, a simulation of different receiver concepts is performed. High potential has the concept with a front fluid channel without a filter, in which the spectral splitting is achieved by the fluid. In this concept thermal decoupling between fluid and PV cell is possible and thus high fluid temperatures can be combined with high electrical efficiency.

References
