A hybrid plant that consists of a gasification system, Solid Oxide Fuel Cells (SOFC) and a Simple Kalina Cycle (SKC) is investigated. Woodchips are introduced into a fixed bed gasification plant to produce syngas, which is then fed into an integrated SOFC-SKC plant to produce electricity. The pre-treated fuel then enters the anode side of the SOFC. Complete fuel oxidation is ensured in a burner by off-gases exiting the SOFC stacks. Off-gases are utilized as heat source for a SKC where a mixture of ammonia and water is expanded in a turbine to produce additional electric power. Thus, a triple novel system based on a gasification plant, a SOFC plant and a SKC plant is presented and investigated. The system is called IGSKC (Integrated Gasification SOFC Simple Kalina Cycle). The system layout is studied, and the optimal ammonia-water mole fraction is selected. An electrical efficiency of 58% is achieved; plant size and nominal power are selected based on the required cultivation area.

SOFC heat recovery with SKC is compared to a Steam Cycle (SC). Although ammonia-water more accurately fits the temperature profile of the off-gases, the presence of a Hybrid Recuperator enhances the available work in the SC case, resulting in a higher overall thermal efficiency.