Highly efficient electricity generation from biomass by integration and hybridization with combined cycle gas turbine (CCGT) plants for natural gas (*Energy*, Elsevier, 2010).

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Abstract. Integration/co-firing with existing fossil fuel plants could give near term highly efficient and low cost power production from biomass. This paper presents a techno-economical analysis on options for integrating biomass thermal conversion (optimized for local resources ~50 MW_{th}) with existing combined cycle gas turbine (CCGT) power plants (800-1400 MW_{th}). Options include hybrid combined cycles (HCC), indirect gasification of biomass and simple cycle biomass steam plants which are simulated using the software Ebsilon Professional and Aspen Plus. Levelized cost of electricity (LCoE) is calculated with cost functions derived from power plant data. Results show that the integrated HCC configurations (fully-fired) show significantly higher efficiency (40-41%, LHV) than a stand-alone steam plant (35.5%); roughly half of the efficiency (2.4 %-points) is due to more efficient fuel drying. Because of higher investment costs, HCC options have cost advantages over stand-alone options at high biomass fuel prices (>25 EUR/MWh) or low discount rates (<5%). Gasification options show even higher efficiency (46-50%), and the lowest LCoE for the options studied for fuel costs exceeding 10 EUR/MWh. It can be concluded that clear efficiency improvements and possible cost reductions can be reached by integration of biomass with CCGT power plants compared to stand-alone plants.