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A Techno-economic Analysis of Anaerobic Digestion and Gasification Hybrid System: Energy Recovery from Municipal Solid Waste in South Africa

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ABSTRACT:

Due to the increased population growth in South Africa, particularly in urban areas, the generation of municipal solid waste has increased and so is the demand of energy. Municipal solid waste can be considered a good candidate for electricity generation in South Africa. This approach does not only have the benefit of recovering electricity from municipal waste, but also contributes to the integrated waste management system. This study aimed to investigate the economic feasibility of hybrid of anaerobic digestion and gasification of municipal waste for electricity generation in South Africa. The research developed a techno-economic model to evaluate the financial profitability of waste-to-energy of gasification, anaerobic digestion and a hybrid system of both waste-to-energy technologies. A spreadsheet was developed to evaluate the financial profitability of waste-to-energy of gasification, anaerobic digestion and hybrid system of both waste-to-energy technologies. The techno-economic model provides cost estimates for the implementation of waste-to-energy technologies in South Africa. This is carried out through a set of financial indicators, namely payback period (PBT), net present value (NPV), profit index (PI), internal rate of return (IRR), levelised cost of electricity (LCOE) and levelised cost of waste (LCOW). Hybrid of gasification and anaerobic digestion manifested positive results across all the financial indicators. The study concluded that a hybrid of anaerobic digestion and gasification waste-to-energy is economically viable. In addition, the hybrid system also provides optimal solution for energy recovery and waste disposal, based on the IRR, LCOE and LCOW values. Sensitivity analysis showed that, energy price and capital expenditure are the major variables affecting the hybrid plant's investment decision.