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ASSESSING THE APPLICABILITY OF SOLAR THERMAL TECHNOLOGIES FOR INDUSTRIAL TEA DRYING

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Abstract – Most process heat being used for various industrial applications is supplied from fossil fuels. Coal, gas, and wood fuel are the most used heat resources which usually power steam boilers for production of heat used in a wide range of industrial processes. Since economic growth is largely linked to industrial production, it implies that a shift towards use of clean energy technologies in industries is crucial to meet the rising demand of process heat while cutting down carbon emissions to mitigate climate change. Solar thermal systems have over the past years shown potential as a practical alternative to fossil fuels for production of heat for several applications, including water and space heating, industrial process heating and electricity generation in thermal power plants. This study seeks to assess the feasibility of employing solar thermal technologies for drying purposes at Tingamira-Tanganda Tea estate in Zimbabwe. Systems advisor model (SAM) was applied to simulate performance of linear Fresnel (LF) and parabolic trough (PT) solar thermal technologies for industrial tea drying. Information on daily heat demand, required process temperatures and current heat sources were obtained to inform the design process of the proposed solar thermal systems. LF system exhibited better techno-economic performance. It requires a smaller collector area (360 m^2) with a lower initial capital cost which is about 8 % cheaper. Moreover, it produces higher annual energy at lower levelized cost of heat for solar multiples higher than 1. Carbon footprint of the factory would be reduced by about 114 tonnes CO_2 annually. Sensible thermal energy storage technology can be considered for back-up heat and heat recovery.

Keywords – Process heat; solar multiple; solar thermal; thermal energy storage