University of the Witwatersrand, School of Architecture and Planning

Energy-efficiency improvement study: a case study of waste heat recovery in selected manufacturing industries in Johannesburg

By

Abosede O. Alao

2282610

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ABSTRACT

Waste energy from manufacturing industries is released as heat, steam or exhaust gases. These released energy forms contribute to the CO_2 emissions of cities where these industries are situated. European countries at large have benefited from previous studies on the estimation of the waste heat recovery potential in industrial processes. Considerable progress into the reduction of energy use, cost and CO_2 emission has been achieved in this region based on these findings. However, research into estimating waste heat recovery and re-use on a production-scale is not fully explored in South Africa due to several factors which include a lack of systemic approach, the cost of waste heat recovery framework, and inaccessible or inconsistent data sets. For this purpose, this study uses a bottom-up approach to assess the waste heat potential to be used for onsite work in three case study manufacturing industries in Johannesburg.

Factory-level data consisting of CO_2 emissions and energy consumption in selected case study manufacturing sites are used in this study to estimate the potential for waste heat recovery. Consideration was given to each manufacturing subsector-specific parameters, and the study finds that low to medium grade waste heat streams is contained in exhaust gases, air and vapour emitted from steam boiler systems, air compressors, heating, and drying processing units; which typically consume a high amount of energy and are generic processing units widely used in manufacturing industries.

About 125,922.44 GJ (34, 978.3kWh) of waste heat with a work potential of between 18.93 to 29.4% representing about one-fifth to a third (20 - 30 %) of the total estimated waste heat streams for all three selected manufacturing case studies was estimated in this research. Given that this waste heat stream is associated with carbon emissions from fossil fuel combustion during manufacturing activities; the study also finds that the recovery of waste heat promises about 7 - 24 % potential savings in energy consumption and about 60 % reduction in CO_2 emissions per year. In light of the finding from the study, it is logical to state that waste heat recovery has the potential for reducing energy demand and cost, as well as a significant reduction in carbon emission from manufacturing industries.

Keywords: waste heat; waste heat recovery; CO_2 emission; energy reduction; manufacturing industries.