ADOPTION OF RENEWABLE ENERGY SOLUTIONS BY SOUTH AFRICAN BEVERAGE MANUFACTURERS – CASE STUDIES

Francois Rozon[1] and Craig McGregor[2]

[1] The Centre for Renewable and Sustainable Energy Studies, corner Banghoek and Joubert Street, Stellenbosch, South Africa, 7600; Phone: +27-83-632-9922; E-Mail: Frozon@sun.ac.za

[2] Mechanical and Mechatronic Engineering, Stellenbosch University; E-Mail: Craigm@sun.ac.za

Abstract: The industrial sector is responsible for over one-third of global greenhouse gas emissions and nearly 50% of global energy demand. While electricity is an essential input for industry, process heat often represents the bulk of energy needs, and it is obtained mainly by burning fossil fuels on-site. For the industrial sector to decarbonise, heavy emitters with high-temperature processes, such as the cement and steel industries, need fundamental changes to production technologies. Industries operating at lower temperatures must drive efficiencies and transform their energy mix. This study complements previous cost-benefit analyses for electricity and thermal energy generated from renewable and sustainable sources at South African beverage manufacturers. It includes a review of investments already made or being considered for a representative sample of beverage facilities. With project investment returns of 20% or more and payback of 2-4 years in South Africa, megawatt-scale photovoltaic and battery energy storage systems are capturing the major share of investment considerations. Immediate benefits include the mitigation against load-shedding events and double-digit electricity tariff increases. Where processes need steam, high-temperature heat pumps and solar thermal energy systems can replace liquid fossil fuels. However, sustainable thermal energy systems are not expected to be cost-efficient against coal for at least another decade. Through a detailed analysis of a returnable bottler washer in a soft drink facility, this research demonstrates that upgrading waste heat streams through industrial heat pumps can reduce the dependence on coal, especially where processes can be converted to hot water systems. Where steam remains a requirement, future studies modelling key processes will remain essential to define financially attractive opportunities. More broadly, policy support and effective carbon taxes will be necessary if industry is to reduce its reliance on coal meaningfully.

Keywords: Industrial decarbonisation; photovoltaics; heat pumps; thermal waste energy; cost-benefit analysis.

1. Introduction

Industry accounts for nearly half of global carbon emissions from electricity and heating requirements, as shown in Table 1 [1], [2]. While global electricity supplies are becoming greener, most industrial process heat continues to be supplied by burning fossil fuels [3]. Industry must, therefore, redesign its processes and embrace renewable and sustainable energy solutions to reduce its carbon footprint [4]. Heavy emitters with high-temperature processes (>1000 °C), such as the cement and steel industries, must pursue change through energy efficiency, carbon capture, electrification, and fuel substitution.[4]. Industry sectors with processes operating with temperatures of less than 400 °C need to focus on energy efficiency and adopt a broader set of renewable energy solutions [5], [6]. These low to medium-temperature process industries represent an estimated 17% of global energy demand [5].

Table 1. Energy sector CO_2 equivalent emission breakdown estimates (2022: 37 billion tonnes)

	Total	Power	Heat
Industry	47%	14%	33%
Transport	26%	-3%	29%
Building	28%	17%	11%
Total	100%	28%	72%

Estimates based on IEA 2019-2022 sectorial energy sector breakdown [1] and 2016 emission global emission categorisation [2]

A three-stage framework has been proposed for reducing the use of fossil fuels by low and medium-process temperature industries, as shown in Figure 1 [7]. Stage 1 advocates ongoing energy efficiency and fuel substitution as the primary pillar. Stage 2 promotes the large-scale adoption of renewable and sustainable energy solutions. Under Stage 3, the framework introduces a broader role for industry as a catalyst to create municipal-level heating and cooling networks to lower overall energy consumption across communities.