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MULTICRITERIA OPTIMIZATION OF RENEWABLE-BASED POLYGENERATION SYSTEM FOR TERTIARY SECTOR BUILDINGS

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Abstract

This manuscript presents the bicriteria optimization of a polygeneration system to be installed in a tertiary sector building, considering economic and environmental objective functions. Electricity, hot water, steam, and cooling demands were considered. The bicriteria problem considered the annual costs and the annual carbon footprint. Updated environmental information was obtained through the application of the Life Cycle Assessment methodology and implemented within a Mixed Integer Linear Programming (MILP) model, along with economic and legal data. Solar photovoltaic energy and biomass were available, as well as natural gas and diesel. The energy system could import and export electricity to the electric grid. Individual optimal solutions were obtained from economic (annual costs) and environmental (annual carbon footprint) viewpoints were different, and the ε-constraint method was utilized to tackle these conflicting objectives. It was verified that significant reductions in annual costs could be obtained if the annual carbon footprint was partially compromised. A configuration based on one gas engine, two biomass boilers and three mechanical chillers was recommended, with an annual carbon footprint of 2,895,909 kg CO_2-eq/year (approximately 570,000 kg CO_2-eq/year less each year in comparison with the economic optimal) at a total annual cost of R$ 1,429,435.

Key words: economics, life cycle assessment, mixed integer linear programming, multicriteria optimization, polygeneration

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