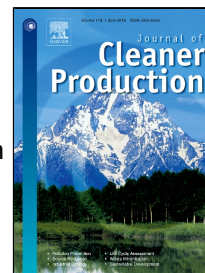


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Techno-Economic Assessment of Different Cooling Systems for Office Buildings in Tropical Large City Considering On-site Biogas Utilization

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Abstract

Rapid development and population increment over the past decades have led metropolises in the tropical regions such as Kuala Lumpur (KL) city to the issue of surging local energy demand, especially cooling energy demand. Most commercial and office buildings install conventional air-conditioning (AC) at individual premises for space conditioning. AC constitutes an average high of 58% of the total energy consumption in a building. In the meantime, the amount of municipal solid waste produced is also proliferating. KL as a city with compact population and limited land mass for waste disposal, the implementation of a large-scale centralised district cooling system (DCS) fuelled with biogas energy seems to be more sustainable. This study aims to assess the performance of various possible cooling system schemes in providing cooling service to office buildings in tropical urban, including the existing AC system and the newly proposed DCS technology integrated with biogas energy. Three parameters which are energy consumption, greenhouse gas emission and economic viability are analysed on a yearly basis. With a total cooling load of 4,008 kW to be supplied to five similar buildings in KL, seven case scenarios involving different cooling schemes of AC and DCS are studied and compared. The result determines that biogas-fuelled cooling systems are as attractive as the grid-electrified systems. Currently, AC unit operating with on-site biogas-generated electricity is the most desirable cooling scheme for KL city, with an annual worth of MYR -1.004 M/y and greenhouse gas avoidance of 41.1 kt CO₂ eq./y. DCS may not be a preferred option yet due to its high investment and operation costs. A sensitivity analysis conducted shows that there is a need to increase the current electricity tariff (up to at least MYR 1.49-1.56/kWh) in order to make DCS more economically attractive as the conventional AC units.

Keywords: Air conditioning; district cooling system; office buildings; biogas energy; tropical cooling demand

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