Effect of operation strategies on the economic and environmental performance of a micro gas turbine trigeneration system in a tropical region.

Firdaus Basrawi a, *, Thamir K. Ibrahim a, Khairul Habib b, Takanobu Yamada c

a. Universiti Malaysia Pahang, Faculty of Mechanical Engineering, 26600 Pekan Pahang, Malaysia
b. Universiti Teknologi Petronas, Department of Mechanical Engineering, Bandar Seri Iskandar, 31750 Tronoh, Perak, Malaysia
c. Kitami Institute of Technology, Department of Mechanical Engineering, 165, Koen-Cho, Kitami City, Hokkaido 090-8507, Japan

Abstract
This study investigates the effect of employment of different operation strategies on the economic and environmental performance of a micro gas turbine trigeneration system (MGT-TGS). The MGT-TGS covers power, heating and cooling load of a selected building in a tropical region. The prime movers used were MGTs with electrical output capacity of 30 kW and 65 kW. Four operation strategies; Power-Match, Heat-Match, Mix-Match, and Base-Load were examined. The Net Present Value and Emissions Reduction Index throughout the life cycle of the MGTs were calculated. It was found that MGT-TGS can only generate positive NPV (Net Present Value) at the end of 25 years life time under unsubsidized electricity price. Mix-Match and Power-Match operation strategies can generate positive NPV because the systems can generate more electricity. However, these operation strategies cannot reduce emissions especially CO₂ and CO when they were compared to a CCGT (Combined Cycle Gas Turbine). Base-Load is the only operation strategy that can reduce all emissions even when it is compared to a CCGT. When the economic and environmental performance is fairly considered using CPERI (Cost Per Emissions Reduction Index), Mix-Match is the optimum solution because it can generate CPERI of US$16.0-92,407, based on NPV.

Keywords: Micro gas turbine, Trigeneration system, Operation strategy, Emissions, Economic

doi.org/10.1016/j.energy.2015.12.117