

Abstract

Institutional swimming pools often have high energy consumption and operating expenses, especially in areas like Palestine that are facing energy shortages. With the goal of drastically lowering thermal losses, operating costs, fuel dependence, and related CO₂ emissions, this study focusses on a thorough energy audit and methodical optimisation of the Half-Olympic swimming pool at An-Najah National University. Reducing the pool temperature setpoint, insulating hot water distribution pipes, installing a motorised pool cover, repairing and improving the current solar thermal collector array, and switching from traditional diesel boilers to an extremely efficient heat pump system were all part of a planned sequence of energy-saving measures. To further improve the sustainability of the system, a 26 kWp photovoltaic (PV) system was added to help offset the heat pump's electricity consumption.

This study amply illustrated the efficacy and viability of each intervention through comprehensive data visualisation and scenario analyses carried out using Tableau software. The energy system configuration that was optimised resulted in a significant 77% reduction in CO₂ emissions and an approximate 95% reduction in annual operating costs. A replicable and scalable model for sustainable energy management in institutional swimming pool facilities is provided by the implemented solutions, which show that it is possible to combine active renewable energy technologies with passive thermal management measures.