## **Energy Performance Assessment of a Zero-Energy House**

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## Abstract

With the continuous economic and population growth and with the implementation of Cost Reflective Tariff (CRT), the building sector is forced to implement new strategies to reduce energy consumption. This research aims to develop design guidelines for residential buildings for the three main predominant climates (Hot-dry, Hot-humid, and Warm-humid) in the Sultanate of Oman. Using an existing 210 m2 eco house instead of a local house and studying the energy performance against nZEB performance metrics. The research methodology consisted of four main phases, firstly, a data collection phase for all necessary information related to the house. Secondly, auditing phase to confirm as-built drawings and survey building systems. Thirdly, energy analysis phase where the house was modelled in DesignBuilder software followed by a validation phase using previous experimental data. The calibrated model was then used to assess the energy status, were results showed that the current performance can be further improved.

Fourthly, different energy efficient measures were tested, and backward analysis was performed by comparing the currently applied passive and active systems with those of a typical Omani house to study their effectiveness. In addition, a sensitivity analysis was performed for the cooling thermostat setpoint to reduce the design parameters tested. Followed by a solar water heater effectiveness test.

Finally, results showed that the currently applied HVAC system can be improved by using either high performance Split ACs or a variable refrigerant volume (VRV) system and that the energy saving can reach up to 62.8% depending on the climate. The results of these tests were used to develop building guidelines per climate.

Overall, this research contributes to the field of sustainable architecture by providing valuable insights into the energy performance of eco houses in diverse climates. The guidelines derived from this study offer practical recommendations for designing and constructing energy-efficient houses, ultimately contributing to the transition towards more sustainable and environmentally conscious building practices.

**Keywords**: Zero-energy building, Energy efficient measures, residential building, DesignBuilder, Oman, Eco house.