**ABSTRACT.**

Retrofitting existing buildings towards NZEB (net-zero energy building) offers significant benefits in terms of reducing operational electricity consumption and operating costs as well as reducing GHG emissions. The increased efficiency and economic cost competitiveness of renewable energy technologies, as well as the advances in building science and energy modelling, continue to evolve along with the increased demand for energy security, thus allowing for advancement of NZEB. But to what extent is NZEB viable for all existing commercial buildings, and what are the technical and contextual parameters that would influence the potential of NZEB retrofits? The study substantiates on these questions via a simulated performance-based analysis of four existing commercial buildings in Durban, with energy modelling and simulation as the primary data sources. The simulation data were then applied towards the assessment of the potential of retrofitting for NZEB based on passive interventions in conjunction with energy-use optimisation of active/mechanical systems and integrated RE technology in the form of site PV.

The study demonstrated a reduction of 27% - 56% in overall grid-electricity consumption and carbon emissions across the case study samples. Lower FAR buildings achieved greater percentage reductions in grid-electricity consumption due to less site shading combined with larger site-area (for PV) to net floor area ratio. Longer operating schedules were also found to increase annual energy consumption while also being better suited for on-site PV generation due to consistent levels of self-consumption. User-density was found to have less significant impacts on overall electricity consumption. Payback periods for NZEB-targeting interventions were enhanced by the recent introduction of the RE tax allowance, which reduced overall payback periods by 2-3 years with two of the case study buildings achieving 4-6 year yields which is considered to be within an acceptable range based on prevailing efficiency and cost levels of the assessed interventions. The study found that the efficacy and practicality of on-site generation PV is limited by grid constraints for building use-types with a high export balance, and for certain high-density sites due to high shading levels. The study recommends smart-grid integration which would connect buildings that can benefit from either consuming or exporting RE and thus ensure annual energy consumption and GHG-emissions in the sub-sector could be brought into line with the 38% reduction compared to the 2050 Nationally Determined Contribution GHG emission reduction targets.

**Key words:** NZEB interventions; retrofitting commercial buildings; energy performance simulation; GHG-emissions reduction.