

## Comparative Analysis of 3-Story Residential Design for a Passive Low Environmental Impact House and Conventional House Using Energy Modeling and Life Cycle Assessment: Case Study Caja PH

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**Abstract :** The increasing demand for energy, and growing concerns for the environment, have led to a greater focus on building energy efficiency and sustainability. Energy modeling and life cycle assessment (LCA) have become essential tools for evaluating building environmental impact and energy performance. This study utilizes Building Information Modeling (BIM) integrated with Energy simulation and LCA, combining two simulation tools, Energy Plus, and Tally, in conjunction with the Revit platform to analyze energy performance during the operational stage and estimate embodied-environmental impacts of a new, low environmental impact house, the Caja PH. The research aims to evaluate energy performance improvements for 3 houses, each with a respective material envelope tested and embodied carbon impacts assessed. The scope of this study will begin with the modeling of a conventional house as the baseline for energy use and embodied carbon emission. The baseline will then be compared to 1) Caja PH, a three-story residential Passive House which is currently under construction, and 2) the modified baseline house to comply with the HERS rating and ASHRAE 90.1 standards. All three houses are tested under the same climatic region. In the end, this work, which is comprised of many phases, serves as a pilot study that will pave the way for the design and construction development of a net zero energy and net zero emission prototypical house in the adopted climate region. The ultimate aim is to offer a blueprint of guidelines for the sustainable design of future residential buildings.

**Keywords :** energy modeling, sustainable buildings, energy efficiency, life cycle assessment, GHG emission, NZE construction, passive house, residential buildings

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