

ZERO ENERGY BUILDINGS

Design Optimization for Net Zero Energy Apartment Buildings in Lebanon: A Parametric Performance Analysis

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CLIMATE CHANGE IMPACTS

LEBANON

WATER SCARCITY
 REDUCED WATER SUPPLY
 DEGRADATION OF WATER QUALITY
 SALINIZATION OF COASTAL AQUIFERS

NATURAL RESOURCES DEPLETION
 LACK OF AVAILABILITY OF RESOURCES NEEDED FOR A WIDE SWATH OF THE ECONOMY AND POPULATION

INCREASE ENERGY DEMAND
 CLIMBING TEMPERATURES, ASSOCIATED WITH CLIMATE CHANGE, WILL ALSO INCREASE ENERGY DEMAND TO MEET THE EVER-RISING COOLING DEMANDS

HEALTHCARE IMPACTS
 ADDITIONAL STRESS ADDED ON AN ALREADY FRAGILE ECO-SYSTEM STRUGGLING TO MEET DEMAND

FOOD SCARCITY
 DECREASED AGRICULTURAL PRODUCTIVITY
 SHIFT IN PRODUCTION ZONES
 LOSS OF PASTURE LANDS AND WATER RESOURCES

These crises have impacted and will continue to impact the well-being, health, and quality of life of large segments of the population, specifically middle to low-income socio-economic sectors.

THE PROBLEM

Conventional Buildings have a significant impact on energy use and the environment, accounting for approximately 20% of global energy consumption and 40% of CO2 emissions. In Lebanon, 30-45% of total energy consumption, primarily generated via fossil fuel, is attributed to the residential sector compared to 25% in regional Mediterranean countries. As a result, Lebanon was ranked 5th in the 2019 Pollution Index at an estimated 76% air pollution rate.

A prominent solution to these problems is adopting Zero Energy Housing (nZEB) as a new construction and design paradigm. A nZEB approach offers households Resiliency, Independence, and Autonomy. Moreover, a nZEB path significantly lessens the financial burden of Lebanese Households. Zero Energy Homes offer a robust path towards achieving Environmental Justice, Social Equity, and Economic Stability. However, despite the benefits, nZEB have not been widely adopted for 3 Reasons:



METHODOLOGY

The fundamental Premise of the research is to affect transformative change to help Lebanese people, utilizing a bottom up approach encompassing the following Steps:

- 1 Conducted Perception Surveys of nZEB & Technical Data/Policy Analysis
- 2 Employed an Iterative Parametric Energy Modeling/Simulation Approach
- 3 Developed Comprehensive nZEB Guidelines & Framework for an App

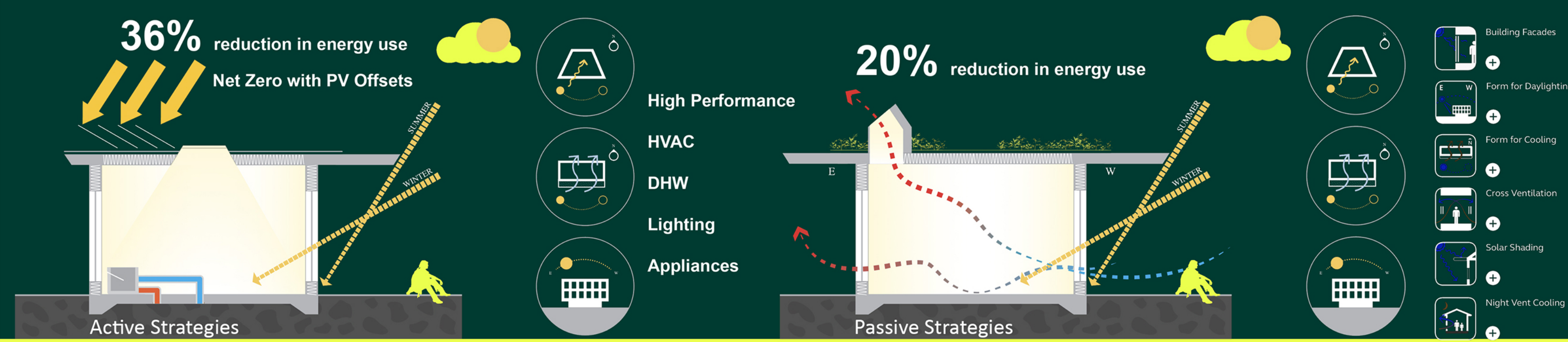
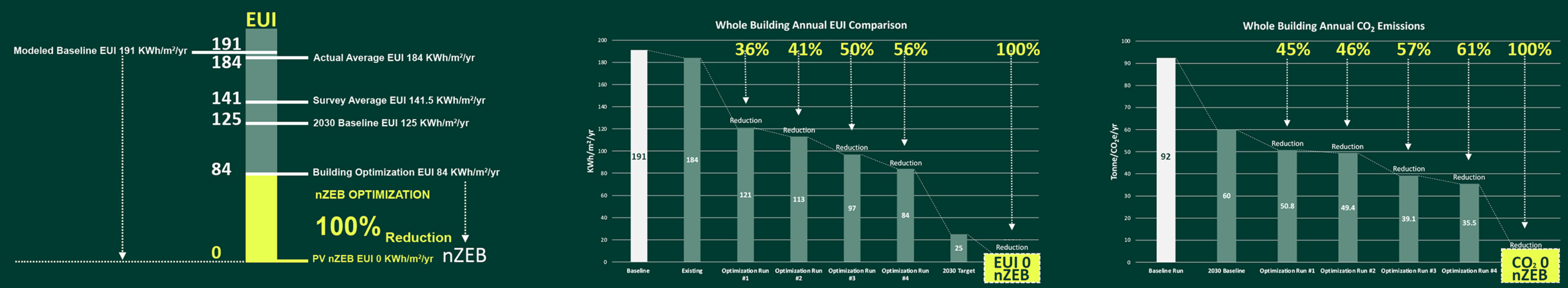
OBJECTIVES

This study aims to introduce and promote Zero Energy Building methodologies into Lebanon's mainstream residential design and construction market. The fundamental premise of the research is providing Lebanese people a viable path towards eliminating energy poverty, providing social equity, and reducing financial strain.

METHODOLOGY



SIMULATION RESULTS



KEY FINDINGS

Collectively, building Design + Systems Optimization upgrades yielded a 56% reduction in Energy Consumption. NZE Optimization (PV integration) yielded 100% reduction in Energy Consumption, 100% reduction in CO2 Emissions, and 100% reduction in Life Cycle Operating Carbon Intensity over the baseline.

DELIVERABLES | Guidelines | Mobile App | Website

CONCLUSIONS | BENEFITS

- Zero Energy Buildings:**
- Provide a Viable Alternative to Traditional Residential Construction in Lebanon.
 - Reduce Energy Consumption and Utility Costs.
 - Provide Economic Independence, Social Equity, Safety & Resiliency.
 - Eliminate Energy Poverty.
 - Reduce Environmental Degradation.



The contribution of this study lies in the development of nZEB Guidelines that could be used by various stakeholders to promote and implement ZEB strategies. The long term implications this study hopes to achieve is the adoption of ZEB as the main design and construction paradigm in Lebanon.