

Single Family Residential Buildings Retrofit Optimization: Atlanta Case Study

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20% of US energy consumption and its consequential environmental impacts is associated with building sector. Residential housing market alone, has a significant impact on U.S. emissions. Residential retrofits have been identified as a key solution to reduce building energy consumption, without consuming a large portion of upfront embodied energy and generating consequential embodied carbon for a new building construction. While increasing home energy efficiency is a national goal, there has been only limited number of homeowners who accept to pursue comprehensive home energy improvements. Even if accepted, it is often done in a “single measure implementation” approach.

The objective of this research is to study residential buildings built over years in city of Atlanta and conduct comprehensive energy, cost and carbon emission retrofit optimization analysis over potential mix of improvements and technologies. The goal is to find the best multi-measure retrofit solution to minimize both cost and energy consumption as well as environmental emissions. For this purpose, we have modeled Atlanta residential buildings built over decades using the Energy Performance Calculator (EPC) building energy modeling tool and conducted sensitivity analysis to find the best possible retrofit option while changing the cost and emission restrictions.

The preliminary results show that by decreasing the retrofit cost, the minimized delivered energy generally increased. The best cost solution is found when minimizing energy while keeping the retrofit cost lower than 30k. Results also indicated that improving the Heating, Ventilation and Air Conditioning (HVAC) system, windows and building insulation have the highest impacts (approximately 60%) on reducing buildings’ energy consumption. The result of this research can be used by policy makers and city planners to implement the best development scenarios for the Atlanta metropolitan area while improving the sustainability and energy-efficiency of the nation.

Keywords: Residential Buildings, Retrofit Analysis, Energy Performance Calculator