Abstract

ENERGY-EFFICIENT RENOVATION OF HOUSES

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The residential sector accounts for about one-fifth of the total United States energy consumption each year. Because new housing replaces old housing slowly, the majority of occupied houses today were built earlier this century, when energy was cheap and houses were generally not built to conserve energy. This thesis examines the energy-efficient renovation of old houses. Because housing renovations are so site-specific, I used a case study building owned by Brown University to learn first-hand about energy-efficient housing renovation. The case study approach is useful for this research, because there are often considerations specific to a particular project, for which abstracted models cannot adequately account. From my experience with this case study, I developed a plan for Brown to follow to do energy-efficient renovations of its small buildings.

My research found that for an old building with loose construction, the most cost-effective measures were those which cut down on infiltration. The case study building has a bizarre heating system that takes in much more fresh air than it needs. Another big heat loss was from poorly sealed window air conditioners. From the calculations, I developed a list of renovations, ordered by cost-effectiveness. If the renovations are considered as a package, the return on investment (ROI) of the whole thing is well within Brown's standard for renovation projects of 0.105, or a payback of 9.5 years.1 However, considered individually, not all the measures meet this criteria. As a package, the short paybacks of the first measures "make up for" the long paybacks of the last measures. Taking the renovation package as a whole will reduce energy use and operating cost.

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1 ROI = (old operating costs - new operating cost) / cost of project, i.e., savings divided by cost. Payback period is the inverse, cost/savings.