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Energy Efficiency Retrofits Case Study - Empire State Building

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Issue

Older buildings such as the Empire State building use more energy and have higher incremental costs for energy efficiency (EE) retrofits than do newer buildings. Throughout New York, 43% of the city's commercial buildings were built before 1945 and create 25% of the city's GHG emissions[i]. A recent report, "A Landmark Sustainability Program for the Empire State Building (ESB)", examined the challenges of a $20 million retrofit of the iconic building. The report provides an excellent case study for heritage retrofit projects around the world. In BC the province's building stock is also aging (only 6-26% of Vancouver's commercial buildings were built or significantly renovated in the last 20 years[ii]) and they produce 5% of the province's emissions[iii], making this stock a good focus for cost-effective EE improvements.

Background

The Empire State Building was completed in 1931 with 2.8 million square feet of office space and currently attracts more than 3.5 million visitors each year to its observation decks[iv]. In 2008, the ESB developed a partnership with five public and private organizations including the Clinton Climate Initiative and Jones, Lang Lasalle, a global real estate firm, to determine the carbon and cost-effectiveness of EE improvements and impacts. The findings suggest that through chiller retrofits, improved insulation, upgraded windows and tenant energy management systems, conservative emission reductions estimates were 38% over projected usage (totaling 105,000 tons of CO_2eq emissions). The study assumes that lower utility and maintenance costs, improved tenant work environments, and the stimulation of higher occupancy rates and rental income will recoup original investments in less than 5 years,[v] achieving a Net Present Value (NPV) of $22 million.

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Three elements of the project represent 'best practices' for commercial energy improvements: its rigorous and transparent planning process, its Energy Service Company (ESCO) partnership, and its use of tenant energy management systems.

The planning team looked at over 60 different EE measures, both independently and in combination with other measures, using a range of tools including their own eQUEST program, to determine the measures' effect on overall emissions and project NPV. They also coordinated the EE improvements with the building's current $500 million capital improvement projects and identified that some of these project costs could be scaled down or eliminated due to EE improvements.

The natural tension between the emission reduction and NPV goals was clear, as the law of diminishing returns applied to the emission reductions. The emission reductions increased in cost from -$200/metric ton for the easiest reductions to $300/metric ton for the final 10% of feasible reductions. The project used an "NPV midpoint" that balanced these two goals. By doing so, they achieved almost twice the emissions reductions than would have been feasible if only NPV had been considered. This NPV was not significantly sensitive to any of the proposed American carbon pricing schemes but very sensitive to the premium that could be charged for rental units. The ESB recognized the importance of their extensive planning process particularly around how to balance emission reductions and NPV. Published public reports, case studies, and sample documents describe these experiences.[vi].

Johnson Controls served as an ESCO for this retrofit. They made many of the improvements including the windows, insulation and chiller retrofit and guaranteed the ESB Company that these measures would reduce the building's energy usage by 61%, thereby reducing the risk for the retrofitter.

The installation of tenant-demand air conditioning and tenant-demand energy management in ESB, combined with workspace guidelines, put greater control of energy use in the hands of users. Tenants track their energy usage on line in real time and receive tips on how to reduce it. Additional ESB tenant incentives included sub-metering and proposed "fee-bates", where tenants who have not reduced energy use are fined and the revenues are redistributed to tenant companies showing EE improvements. Metering and tenant incentives have been shown in one meta-study to reduce energy use by 5-15%[vii].

Recommendations

Recognizing that commercial building stock may be a cost-effective way of increasing EE and reducing associated emissions, Canada, BC, and a number of utility companies have created regulations and incentive and audit programs to encourage retrofits. However, in Canada, there is still a sub-optimal number of commercial building EE retrofits occurring--between 1990 and 2003 commercial-building energy intensity rose by 10%.[viii]

In addition to the three notable ESB planning lessons (above), there are three key steps that should be taken to facilitate EE retrofits in BC. These include:

1. **Strategic timing with planned capital improvements**

Coordinating EE improvements with planned capital improvement is more effective for businesses. Most energy efficiency improvements have a positive NPV when they account for the incremental cost of the EE feature rather than the complete cost of the project.

2. **Coordinated financing options**

Financing options that guarantee a recouped revenue stream for building owners, reduce uncertainty, and help to finance the incremental costs of energy improvements will help to overcome financing barriers. Although the ESB was able to fund its retrofit through operating cash flow, the high up-front costs this lack of availability of financing is a major barrier for would-be commercial EE retrofitters. In this area, Canada lags behind the United States, which has over 110 commercial EE loan programs[ix]. The province can address this financing gap in two ways. First, they could incentivize the use of ESCOs, which, although not new, could scale up their involvement in EE planning and project development and provide the certainty necessary for the building owners to invest in EE improvements. Second, they could encourage BC Hydro, which already has the mandate to lower projected energy usage by 50% by 2020, to finance retrofit programs that would meet the needs of both the utility and the building owner.

3. **Enacting a commercial renovation by-law**

BC has set a target of 9% reduction in emissions per square foot for commercial buildings but has not yet enacted formal regulations to achieve this. However, the City of Vancouver's proposed residential renovation by-law, requiring homeowners to implement progressively higher EE improvements based on the overall cost of the renovation, could serve as a successful example. A renovation by-law allows building owners to make their energy efficiency improvements at a time of their choosing.

Conclusion

Retrofitting older commercial buildings holds great potential for reducing emissions. Lessons learned from the ESB demonstrate that energy efficiency retrofits are not only possible but also profitable for building owners. Coupling appropriate regulations with the provision of financing programs will encourage commercial energy efficiency retrofits.

Further Reading

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