RetroFit

AN RMI INITIATIVE

Retail Chain Case Study

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Overview Section

Location: Across the U.S.
Building Owner: Confidential
Building Type: Small Volume High Profit Retail Franchise
Marginal Capital Cost of Retrofit: $4.70–$9.60 per square foot
Total Cost of Retrofit: $6.30–$21 per square foot
Building Size: 43,000–58,000 square feet
Completion Date: 2011
Annual Energy Use: 36–79 kBtu per square foot current; 10–43 projected
Annual Energy Cost Savings: $50,000–$80,000

With profit margins getting tighter in light of the recent economic downturn, leaders of one retail franchise recognized that their thousands of individual storeowners needed help reducing their operating expenses and differentiating themselves from competitors. In addition, the leaders believed that their corporate strategy should better demonstrate social responsibility. To complement the sustainable strategies already in place for product development, the leaders created a plan to reduce energy costs across the chain of retail stores.

In typical retail buildings, lighting accounts for 53 percent of the total energy use and, for this retailer, it was even higher. With such a large portion of the energy use coming from a single source, the energy solution may have seemed obvious. However, realizing that there may be an opportunity for higher value retrofits, the retail chain worked with RMI to evaluate more comprehensive solutions through a deep energy retrofit.

The team conducted deep energy retrofits of three typical stores in various climate zones and identified energy efficiency measures that could be cost-effectively replicated across the entire chain. This enabled the retail chain to develop a strategic plan that helps individual storeowners reduce their energy costs, without duplicating analysis, thus reducing retrofit costs. This corporate level strategic plan, which has not yet been released, will likely include systematic outreach to the storeowners, an online database of efficiency measures, vendor partnerships to consolidate and reduce cost and development of financing strategies.

The recommended package of measures for scaling across the portfolio included:

- Interior and exterior lighting redesign and/or replacement

Modeled financial investment and payoff for each pilot retrofit

	Pilot Retrofit #1	Pilot Retrofit #2	Pilot Retrofit #3
Total capital cost for retrofit:[1]	$11/GSF	$6/GSF	$21/GSF (Included building addition)
Marginal capital cost:[2]	$7/GSF	$5/GSF	$10/GSF
Annual utility cost savings (and dollar value):[3]	72% ($50,000)	44% ($78,000)	48% ($80,000)
Internal rate of return:[4]	14%	12%	13%

All costs presented in 2009 US dollars.
[1] Includes all soft costs for design, consulting and construction. Does not include corporate administrative time.
[2] This cost is incremental to a business-as-usual baseline, which represented the necessary upgrades that would have been required outside of the efficiency projects.
[3] Savings measured against pre-retrofit utility costs.
[4] 10-yr analytical period; 4 percent energy cost escalation; 8 percent discount rate.

- Lighting controls (dimmable ballasts with daylight sensors and timed controls)
- HVAC replacement (at the end of its lifespan) with high efficiency, smaller capacity units (due to load reduction strategies)
- Radiant heaters for specific applications in climates that required heating
- Programmable thermostats
- Building recommissioning

These measures could be implemented across the portfolio with less than a 5-year simple payback per store.

Financial Analysis

The table below summarizes the financial results for the pilot retrofits. The retail corporation subsidized the retrofit cost in order to increase the rates of return for the owners of the pilot stores to 20 percent, which is the financial hurdle rate for typical storeowners.

The team estimated that 60 to 80 percent of the pilot store energy cost savings could be replicated across the entire chain with minimal corporate administrative time as well as minimal design and analysis. As a result, the team anticipates that roughly 30 to 50 percent of the energy cost in stores across the country could be saved, for a five-year simple payback or less.

Additional Benefits

While the major concern for storeowners was reducing cost, they were also interested in providing a better indoor environment for their customers and employees, which often indirectly results in increased occupant productivity and increased sales. Storeowners wanted to emphasize the sales product, as well as the social benefit of having customers recognize that their store was more environmentally friendly.

One storeowner was interested in going beyond the recommended retrofit to boost the "green" image of the store, primarily by installing solar PV on the front of his building. He was already committed to implementing a very aggressive energy efficiency retrofit, but since many of the upgrades resulted in physical changes that were hidden on the roof or in the ceiling, he felt that they would not be apparent enough to most customers.

Another storeowner wanted daylighting for its improved quality of light and color rendering on the sales product. Workers in his other stores have asked him to install skylights in their location as well, since they enjoy working in a daylit environment. Because of this experience, the storeowner was adamant about installing daylighting in offices and other non-sales areas to boost worker satisfaction and productivity. For more on the benefits of daylighting in retail environments, refer to the Heschong Mahone study: www.h-m-g.com.

Deep Retrofit Scope

The table on the following page lists the measures the storeowner selected for one of the pilot retrofits. These measures range from a complete lighting redesign to installing an airtight door between adjacent unconditioned and conditioned spaces. To help the client understand which measures saved the most energy and, more importantly, how the measures impact one another, the team provided a capital cost estimate, energy cost savings, and notes on the interdependency among measures. The design team estimated that a condensed package of these measures could be implemented in similar stores for return on investment that meets a typical storeowner's hurdle rate. Measures in this condensed package are in italics.

Deep Retrofit Process

At the onset of the project, RMI and the ownership team agreed about the end result they were working together to create: Operational cost savings for individual retailers. The team's work process revolved around this shared goal. Throughout the project, the team used weekly calls to keep everyone abreast of progress and to effectively navigate around challenges and avoid any surprises.

The project team followed these main steps:

1. Kick-off workshop

The project team conducted a workshop early on to clarify the objectives and identify what a successful project would look like. The team members discussed what sort of process they should use to select pilot stores, preliminary analysis findings, and identify potentially replicable measures. The team also examined institutional mechanisms and policies the owner could put into effect to replicate the efficiency measures across the entire portfolio of stores. These mechanisms included a prototypical design for new stores and minimum component performance specifications.

2. Selecting the pilot stores

In order to identify one or more typical stores that could represent the whole portfolio, the team identified important variations among the portfolio of

Retrofit #1				
	Measures ings[2]	**Marginal capital cost[1]**	**Annual energy cost sav-**	**Notes on interdependency of measures**
Lighting	Daylighting: add skylights and light pipes	$76,000	$15,000	Includes redesign of the lighting system to reduce the number of fixtures, thus saving capital costs. Increases cooling load.
	Upgrade interior lighting and add controls	*$63,000*	*$26,000*	*Reduces cooling load*
	Upgrade exterior lighting and add controls	$35,000	$14,000	
Heating, Cooling, and Ventilation	*Replace HVAC system and thermostats*	*($18,000)*		*To achieve capital cost reduction, implement cooling load reduction measures*
	Add weather-stripping and caulking	$2,200	$400	Reduces cooling load
	Add automatic door controls (to shut off HVAC when doors are left open)	$1,500	$350	Reduces cooling load
	Replace existing wall fans with one high-volume, low-velocity fan	$7,300	$1,300	
	Install door between conditioned and unconditioned spaces	$1,500	$70	Reduces cooling load
	Add variable-speed ceiling fans	$3,000	$1,300	Reduces cooling load
Other	Reduce plug-load standby power; purchase Energy Star equipment; seal duct leaks, etc.	$3,900	$1,300	
Water	Xeriscape and drip irrigation	$14,000 $5,700		
	Rainwater capture	$5,100	$450	
	All measures listed above	**$230,000**	**$50,000**	**Note: Annual energy cost saings are not cumulative due to the interactive effect of individual measures.**

[1]These costs are incremental to a business-as-usual scenario, which represented the necessary upgrades that would have been required outside of the efficiency projects. Design, consulting and analysis costs are excluded.
[2] Savings are unverified and calculated against pre-retrofit conditions.
[3] The team estimated a negative cost for HVAC replacement due to less heat generation in the spaces enabled a reduced cooling load by over one-third. The business-as-usual upgrade including replace the existing packaged units in-kind, with the exception of one unit that needed a size increase.

Overview of selected stores

	Retrofit #1	Retrofit #2	Retrofit #3
Location	Florida	Nevada	New York
Space use	Retail	Retail	Retail
Building Size (GSF)	43,000	98,000	52,000
Climate	Hot and humid	Hot and dry	Cool and humid

stores. The team asked several questions, such as:

- Do the buildings have a similar size, shape, or number of floors?
- Is the function of the space similar?
- Are the buildings located in similar climate zones? Do they have access to similar wind and/or solar resources?
- Do the buildings have similar HVAC systems?

Nearly all stores were small (less than 60,000 square feet), single story, had similar HVAC systems (i.e., packaged units) and similar space functions. Since the major variation across the chain was climate, the team sorted the buildings according to distinct climate zones.

After sorting the stores into climate zone groups, the team needed to select representative stores for a pilot deep energy retrofit. The team looked for stores whose managers were excited about the retrofit project and wanted the store to become a model for the rest of the chain. Also, the team made sure the store was ready for a retrofit.

3. Conducting deep retrofits

The team began the deep retrofit pilots by clarifying the objectives, which were to meet the storeowners' needs and to reduce energy costs as much as possible with a good return on investment. In this case, a 'good' return on investment was somewhat loosely defined. For this reason, the team developed two options from which the storeowner could choose: a bundle of measures that reduced energy cost as much as possible for a five-year payback, and another bundle of measures that maximized energy cost reduction for a six- to 8-year simple payback.

RMI led the analysis and retrofit of the stores. This process is detailed in a generic form in the How to Retrofit. We highlight several key aspects below, including establishing the business-as-usual scenario and developing bundles of efficiency measures.

Documenting the business-as-usual scenario

As discussed in the Document the Business-as-Usual Scenario in the How to Retrofit section, it was necessary for the team to identify any upcoming replacements or renovations in order to calculate the marginal cost of the energy efficiency retrofit. While challenging, this exercise is essential and, more importantly, it helps to get the full team in alignment on the marginal costs of the improvements (the marginal cost is the difference between the business-as-usual upgrades that are necessary to keep a building functional and the cost of the higher efficiency component).

Not surprisingly, these smaller commercial building owners did not have comprehensive replacement or renovation plans. Instead, components were typically replaced only upon failure. Thus, RMI worked with the building owners to determine which equipment and components needed to be replaced and when the replacements would be scheduled.

The table below presents the anticipated replacements for one store. Six out of the eight packaged units were seven to eight years old, in poor condition, and needed replacement. While packaged units can last up to 20 years, a more typical lifetime is five to ten years and these units had little regular upkeep were prone to frequent breakdowns. In addition, one packaged unit was grossly undersized and could not provide comfortable conditions for an office space. If it were to be replaced without implementing any load reduction measures, the five-ton packaged unit would need to be replaced with an eight-ton unit, which would require additional structural support.

Other items, in addition to the packaged units, required replacement. The built-up roofing was 40 years into its roughly 30–50-year lifecycle and given its actual condition, it was ready for replacement. Smaller items, such as a broken condensate removal system and a thermostat, were also recommended, despite their comparatively minor cost.

During a meeting to discuss possible efficiency measures, the storeowner and his general contractor both confirmed RMI's assessment that the

Anticipated business-as-usual replacements			
Building component	**Age (yrs) and condition**	**Expected service life (yrs)**	**Source**
Rooftop unit A/C	7–8, poor	15	Chapter 36, ASHRAE Handbook 2007
Built-up roof	40, fair	30–50	Kirk and Dell'Isola 1995
Condensate removal; thermostat	N/A, Items are broken	N/A	N/A
Windows	30, fair	40	Kirk and Dell'Isola 1995

Replacements defined in the business-as-usual scenario		
Building component	**BAU replacement schedule**	**BAU replacement description**
Six packaged unit A/Cs	Immediate	Code-compliant packaged units; additional structural support for one unit
Built-up roof	Year 5	Replacement in kind
Condensate removal, thermostat	Immediate	Replacement in kind

packaged units were due for replacement, and that the one packaged unit would require additional structural support. They also confirmed the need for condensate removal and new thermostat. The general contractor thought the roof probably had a few more years left, but since other disturbances would be taking place in the building anyway for the packaged unit replacements, he advised the owner to accelerate the roof's replacement cycle. RMI accounted for this recommendation in the baseline by defining a roof replacement in five years. The windows were not included in the business-as-usual baseline because the owner had requested a life cycle cost analysis period no greater than ten years, and the windows had ten years of service life remaining. The table below presents the mutually agreed-upon baseline.

Developing bundles of efficiency measures

As discussed in the Identify Opportunities section of How to Retrofit, the team needed to bundle measures together to account for synergies between them.

To develop bundles of efficiency measures, team bundled highly cost-effective measures to subsidize other measures with less quantifiable benefits. In addition, the team used load-reducing measures to downsize HVAC equipment.

Two very cost-effective measures helped build a case for implementing some of the other measures with benefits that were harder to quantify, such as daylighting. The first cost-effective measure was the lighting retrofit, a complete redesign for a 30 percent return on investment. This high return could be accomplished because the existing system was very inefficient and the designers took care to provide light only where and when it was needed.

The second cost-effective measure was the replacement of the packaged HVAC units, which had a negative marginal capital cost because the system could be downsized compared to the business-as-usual baseline. Downsizing the packaged units reduced their capital cost and avoided the cost of adding structural support for one new, larger packaged unit. In addition to cost savings, the downsizing enabled RMI to specify small split-system units with efficiency ratings that are higher than what is possible in larger single-packaged units.

Tools

For energy and financial modeling, RMI used eQUEST, RMI's LCCA tool, and other tools that can be found in the Energy Modeling Toolkit section.

Energy Use Operating data

Projects are still being implemented, data is forthcoming.

Lessons Learned

This case study shows how leaders of a retail chain strategically selected buildings for deep energy retrofits with the intent of eventually retrofitting their entire chain. By using deep energy retrofits to identify strategies and produce data, the retail corporation will enable the individual storeowners to save more energy and capture more value.

Using deep energy retrofits for reducing energy consumption across a portfolio is more effective than conventional approaches, for two reasons:

- Higher quality design, deeper savings. A conventional approach to reducing energy across a portfolio includes identifying one or more components that could be replaced in each building for modest efficiency gains. In contrast, through a deep energy retrofit of the pilot stores, the team was able to produce higher quality designs that save more energy and can be replicated across hundreds of stores. For example, instead of a conventional upgrade in lamps and ballasts to provide similar light using less energy, the team redesigned the lighting strategy for a better visual environment and even less energy. The new design better displays the sales product and provides light only when and where it is needed.
- Opportunities to downsize. In a conventional approach, heating and cooling loads are rarely recalculated and new HVAC equipment is rarely resized. In contrast, the design team developed load-reducing strategies to downsize mechanical equipment, recalculated the loads, and, for one store type, identified smaller systems that can run at much higher efficiency.

Additional lessons from this Retail project include:

- For the pilot retrofits, life cycle cost analysis requires careful planning and coordination. Since the integrative design process was iterative, many of the capital and energy cost estimates needed to be updated several times. Moreover, the designers needed to have continuous access to the data. To avoid confusion and other headaches, the team needed to develop a careful plan as to when data would be updated and how designers would access it.
- Measures do not have to be implemented all at once within a store. For financial or other reasons, storeowners may need to implement the replicable efficiency measures over time rather than all at once. For obvious reasons, measures that reduce heating and cooling loads should be implemented before the HVAC is upgraded.