National Action Plan for Energy Efficiency
Sector Collaborative on Energy Efficiency
Retail Store Energy Use Profile

According to the Edison Electric Institute, the cost of energy accounts for anywhere from three to eight percent of a retailer's total operating expense. There are significant opportunities for energy use reduction, cost savings, and the mitigation of greenhouse gas emissions through cost-effective energy efficiency opportunities. To help identify the best opportunities, both from the perspective of the building owner and the utility, it is important to examine how, where, and when energy is used and the savings are likely to occur.

The following profile will first provide high-level energy consumption and cost metrics for the retail sector. Next, representative daily load shapes for a typical retail store will be presented; one of these load shapes will reflect a "baseline" building scenario, while the others will represent this same building following the implementation of a package of cost effective energy efficiency measures. Finally, these building scenarios will be benchmarked with the EPA's energy performance rating system (under development for retail buildings) in order to demonstrate the relationship between energy use and the 1-100 rating.

Average Energy Consumption, Cost, and End-Use Figures

Across the United States, the average annual energy intensity for retail properties is 81.5 kBtu per square foot and the average cost is $1.57 per square foot. Of the total energy consumption, 67% is for electricity and 33% is for natural gas and other fuels. This translates to 16.1 kWh per square foot of electricity and 0.27 therms per square foot of natural gas[1].

As show in Figure 2, space conditioning, lighting, and office equipment together account for 80% of all energy consumed in a typical retail property. The remaining energy is consumed by refrigeration, water heating, cooking, and other miscellaneous uses.

Table 1 – Annual Energy Consumption per Square Foot

	Consumption per Square Foot (Billing units)	Energy Use Intensity (kBtu/sf)
Electric	16.1 kWh/sf	54.9
Natural Gas	0.27 therms/sf	26.6
Total		**81.5**

Figure 1 – Energy Consumption by Fuel Type

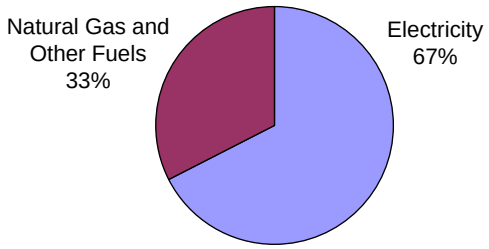
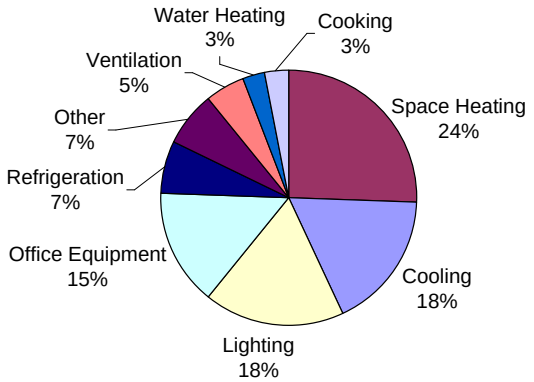


Figure 2 – Total Energy Consumption by End Use
Adapted from E Source, 2006



[1] Based on the 2003 EIA Commercial Building Energy Consumption Survey (CBECS). For the purposes of illustration, all non-electric energy consumption has been converted to the equivalent consumption of natural gas. Other fuels may include oil, steam, and propane.

Breaking energy end-use down one step further, we see that the major energy end uses in retail properties differ according to fuel type. Of course, any individual building may have a different end use breakdown than the "typical" building; for example, an all-electric building would have no natural gas consumption, and would have a breakdown of electric use that would look similar to the total energy end use breakdown in Figure 2.

Figure 3 – Electric Consumption by End Use
Adapted from EEI, 2001

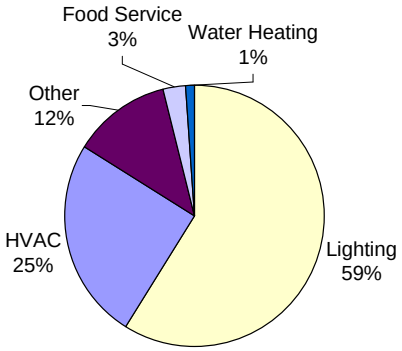
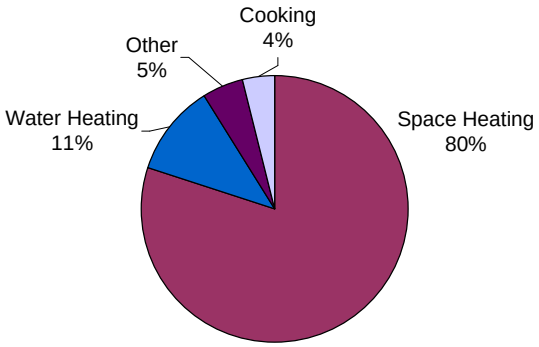


Figure 4 – Natural Gas Consumption by End Use
Adapted from EEI, 2001

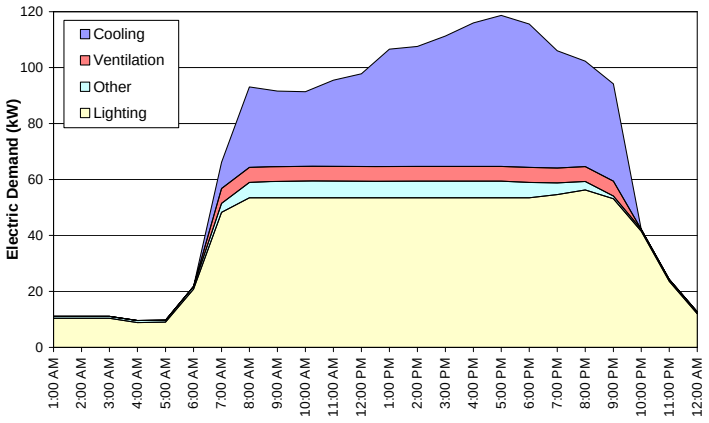


Daily Load Shape

Load Shape – Baseline Scenario: The load profile below represents a baseline scenario for daily operations at a "typical" retail store on a summer weekday[2]. This load profile illustrates the contributions of lighting, cooling, ventilation, and other loads throughout the day. Total building energy consumption in retail stores ramps up quickly in the morning before the store opens, and down again after the store closes at night.

Figure 5 - Typical Retail Store Load Profile – Baseline Scenario

Assumptions
- 30,000 square foot retail store
- Packaged rooftop DX unit with gas furnace
- 9:00am – 9:00pm, Mon-Sat
- 10:00am – 7:00pm Sun
- Chicago, Illinois
- Typical summer day



With Efficiency Measures: The following load profiles illustrate the "typical" retail store after the implementation of three different packages of energy efficiency measures. Operations and maintenance or re-commissioning measures generally represent low or no cost opportunities that should be a first step in energy management efforts. Lighting measures require capital investment, but have a relatively low simple payback. The full package of measures includes more comprehensive equipment upgrades.

[2] Load profiles were developed using eQUEST, a DOE-2 based software tool.

Figure 6 – Load Profile with Operations & Maintenance / Re-commissioning Measures

Measure List

- Optimize Temperature Setpoints
- Optimize Lighting and HVAC Scheduling
- Demand Controlled Ventilation
- Economizer Operation
- Power Management Enabling for PCs, Printers, and Copiers
- Turn off Registers and other Plug Loads at Night
- Specify ENERGY STAR Equipment – Office Equipment, Vending Machines

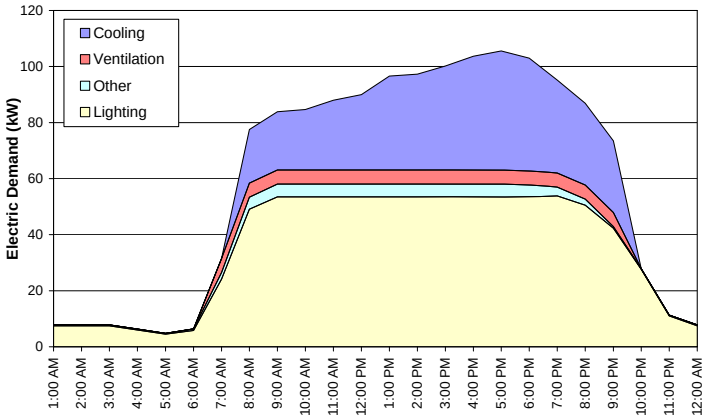


Figure 7 – Load Profile with Lighting Measures

Measure List

- Efficient Lighting (High Performance T8/T5, CFLs, LED Exit Signs)
- Occupancy Sensors (back rooms)
- Daylighting with Skylights

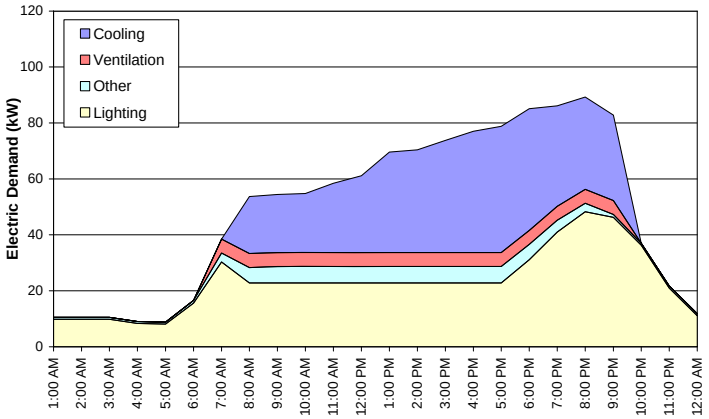
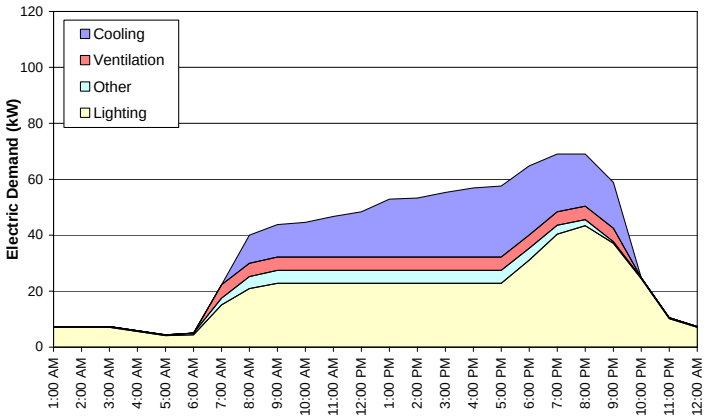


Figure 8 – Load Profile with All Measures

Measure List

- Includes all O&M / Re-commissioning measures
- Includes all Lighting measures
- High-Efficiency Packaged RTUs



The load profile after the implementation of operations and maintenance measures shows savings at the beginning and end of the work day due to the shortening of HVAC and lighting schedules. It also shows a reduction in peak demand from temperature setpoint changes and demand controlled ventilation, and a reduction in overnight energy consumption from turning off unnecessary lights and equipment. The lighting measures reduce peak demand, partially

because of the more efficient technology, but the greater impact is from the use of daylighting. In addition to the savings from O&M and lighting, the load profile with the full package of measures shows reductions in peak cooling demand as a result of high efficiency packaged rooftop units. The total reduction in peak demand for this building on a typical summer day is 50 kW, or 42% of the baseline.

On an annual basis, the savings from the full package of measures results in a reduction in energy intensity of 25 kBtu per square foot, or 28% of the baseline. This translates to $18,685 per year at national average utility rates of $0.094 per kWh and $1.16 per therm[3].

The energy performance of each of these building scenarios can be benchmarked using the EPA's energy performance rating system. This tool allows building owners and operators to enter building attributes and consumption data and obtain a 1-to-100 rating, normalized for weather and occupancy, which compares a given building to its peer group. (The rating for retail buildings is currently under development, and is expected to be released soon. The results presented here are based on a preliminary model.) In the baseline scenario, the property received a rating of 44[4]. Factoring in the hypothetical energy efficiency measures that were applied to this building, the energy performance rating increased to 75.

Annual electric and natural gas savings, energy intensity savings, peak demand reductions, cost savings, and energy performance ratings for each of the energy efficiency measure scenarios are included in Figure 9.

Figure 9 – Energy Savings Summary

Scenario	Electric Use (kWh)	Electric Savings (kWh)	Electric Savings (%)	Natural Gas Use (therms)	Natural Gas Savings (therms)	Natural Gas Savings (%)	Annual Energy Intensity (kBtu/sf)	Energy Intensity Reduction (%)
Baseline	455,000	--	--	10,788	--	--	88	--
O&M	392,000	63,000	14%	7,325	3,463	32%	69	**21%**
Lighting	329,000	126,000	28%	13,718	-2,930	-27%	83	**5%**
All Measures	267,000	188,000	41%	9,915	873	8%	63	**28%**

Scenario	Peak Demand (kW)	Demand Reduction (kW)	Demand Reduction (%)	Energy Cost ($)	Energy Savings ($)	EPA Energy Rating
Baseline	119	--	--	$55,284	--	**44**
O&M	106	13	**11%**	$45,345	**$9,939**	**59**
Lighting	89	29	**25%**	$46,839	**$8,445**	**60**
All Measures	69	50	**42%**	$36,599	**$18,685**	**75**

[3] Based on Energy Information Administration data for 2006.
[4] Assumptions entered into Portfolio Manager include 30,000 square feet, main shift staffing of 12 people, 81 operating hours per week, 8 registers, and 3 personal computers.