National Action Plan for Energy Efficiency
Sector Collaborative on Energy Efficiency
Supermarket Energy Use Profile

It has been calculated that a 10% reduction in energy costs for the average supermarket is equivalent to increasing net profit margins by 16%. These financial results are well within reach, since there are significant opportunities for energy use reduction, cost savings, and the mitigation of greenhouse gas emissions through cost-effective energy efficiency measures. 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 grocery sector. Next, representative daily load shapes for a typical supermarket 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 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 grocery stores is 213.1 kBtu per square foot and the average cost is $4.84 per square foot. Of the total energy consumption, 82% is for electricity and 18% is for natural gas and other fuels. This translates to 51.3 kWh per square foot of electricity and 0.38 therms per square foot of natural gas[1].

As show in Figure 2, refrigeration alone accounts for over 35% of the energy consumed in a typical grocery store. Just over 50% is used for space conditioning, lighting, and office equipment. The remainder is consumed by cooking, water heating, and other miscellaneous uses.

Table 1 – Annual Energy Consumption per Square Foot

	Consumption per Square Foot (Billing units)	Energy Use Intensity (kBtu/sf)
Electric	51.3 kWh/sf	175..0
Natural Gas	0.38 therms/sf	38.1
Total		**213.1**

Figure 1 – Energy Consumption by Fuel Type

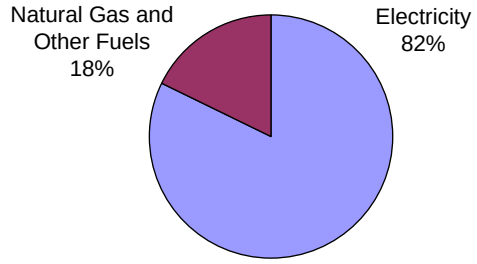
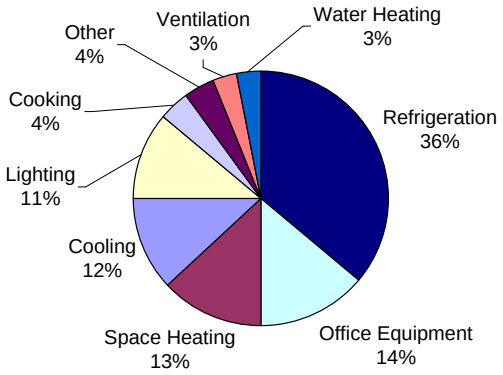


Figure 2 – Total Energy Consumption by End Use
Adapted from E Source, 2006



[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.

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Breaking energy end-use down one step further, we see that the major energy end uses in grocery stores 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

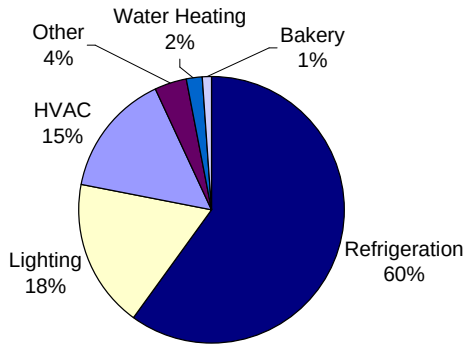
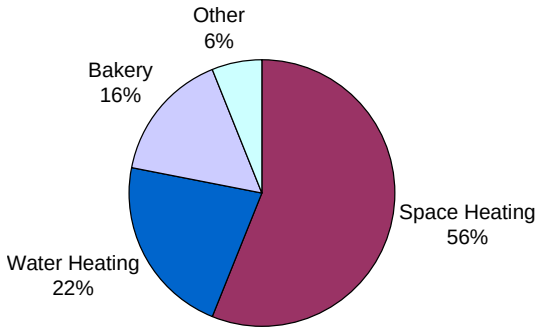


Figure 4 – Natural Gas Consumption by End Use
Adapted from EEI, 2001



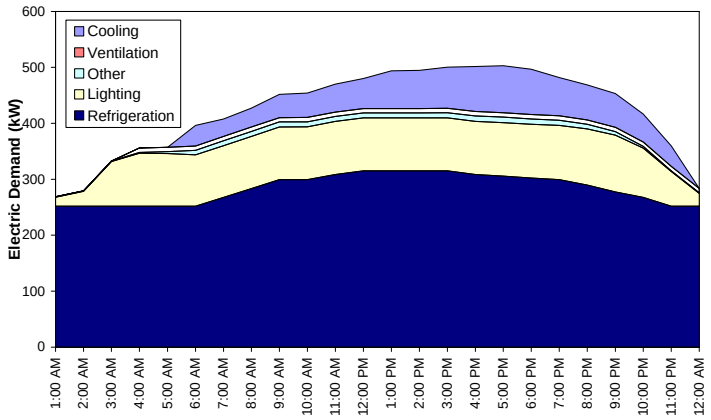
Daily Load Shape

Load Shape – Baseline Scenario: The load profile below represents a baseline scenario for daily operations at a "typical" supermarket on a summer weekday[2]. This load profile illustrates the contributions of refrigeration, lighting, cooling, ventilation, and other loads throughout the day. Total building energy consumption in supermarkets increases early in the morning when employees come in to prepare for store opening, and decreases after the store closes at night. Supermarkets have a high base load at night due to the large amount of refrigeration equipment.

Figure 5 - Typical Supermarket Building Load Profile – Baseline Scenario

Assumptions

- 45,000 square foot supermarket
- Packaged rooftop DX unit with gas furnace
- 7:00am – 11:00pm, Mon-Sat
- 7:00am – 9:00pm Sun
- Chicago, Illinois
- Typical summer day



With Efficiency Measures: The following load profiles illustrate the "typical" supermarket 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

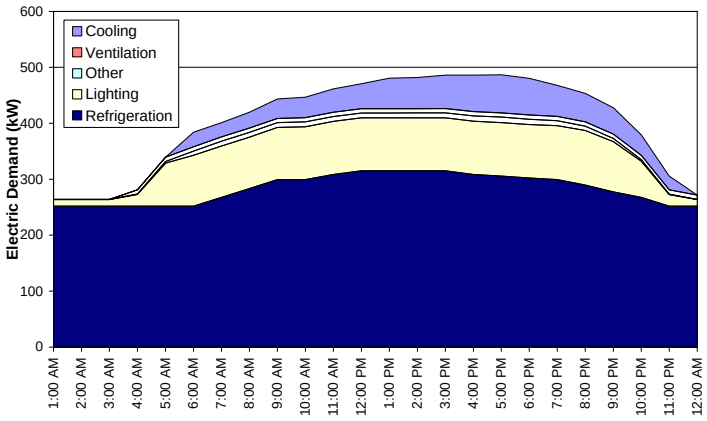


Figure 7 – Load Profile with Lighting Measures

Measure List

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

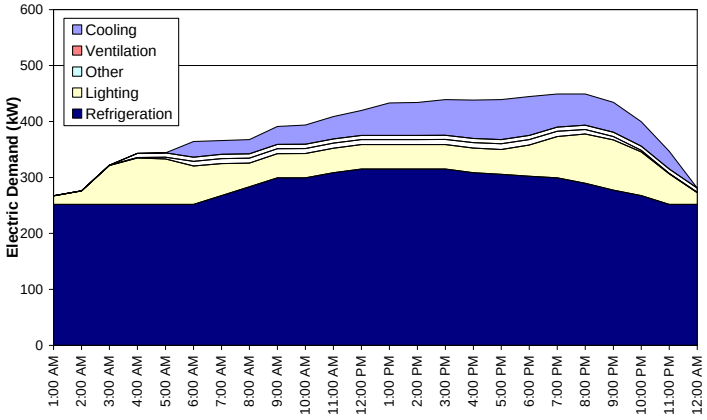
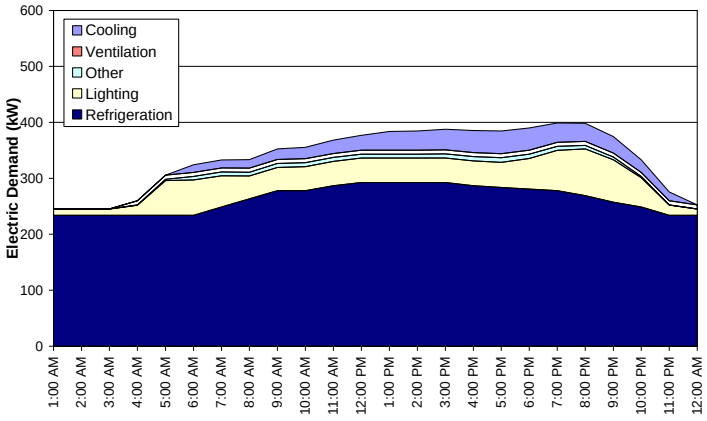


Figure 8 – Load Profile with All Measures

Measure List

- Includes all O&M / Re-commissioning measures
- Includes all Lighting measures
- High-Efficiency RTUs
- Antisweat Heater Controls
- ECM Motors for Display Cases and Walk-ins
- Evaporator Fan Controls for Walk-in Coolers



The load profile after the implementation of operations and maintenance measures shows the greatest 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 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 rooftop units and a reduction in refrigeration energy from efficient motors and controls. The total reduction in peak demand for this building on a typical summer day is 104 kW, or 21% of the baseline.

On an annual basis, the savings from the full package of measures results in a reduction in energy intensity of 46 kBtu per square foot, or 15% of the baseline. This translates to $54,613 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. In the baseline scenario, the property received a rating of 67[4]. Factoring in the hypothetical energy efficiency measures that were applied to this building, the energy performance rating increased to 80.

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	3,423,000	--	--	18,028	--	--	300	--
O&M	3,294,000	129,000	4%	10,849	7,179	40%	274	**9%**
Lighting	3,190,000	233,000	7%	23,540	-5,512	-31%	294	**2%**
All Measures	2,864,000	559,000	16%	16,246	1,782	10%	253	**15%**

Scenario	Peak Demand (kW)	Demand Reduction (kW)	Demand Reduction (%)	Energy Cost ($)	Energy Savings ($)	EPA Energy Rating
Baseline	503	--	--	$342,674	--	**67**
O&M	487	17	**3%**	$322,221	**$20,454**	**72**
Lighting	449	54	**11%**	$327,166	**$15,508**	**71**
All Measures	399	104	**21%**	$288,061	**$54,613**	**80**

[3] Based on Energy Information Administration data for 2006.
[4] Assumptions entered into Portfolio Manager include 45,000 square feet, main shift staffing of 45 people, 110 operating hours per week, the presence of a food preparation facility, 16 registers or personal computers, 55 refrigerated and freezer cases, and 5 walk-in coolers and freezers.