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

Utility expenditures represent the fastest-growing operating cost for hoteliers, increasing by an average of 12% per year from 2004 to 2006,[1] and one of the largest controllable costs. There is a significant opportunity 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 lodging sector. Next, representative daily load shapes for a typical lodging property building 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 hotels and motels is 87 kBtu per square foot and the average cost is $1.42 per square foot. Of the total energy consumption, 61% is for electricity and 39% is for natural gas and other fuels. This translates to 15.6 kWh per square foot of electricity and 0.34 therms per square foot of natural gas[2].

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

Table 1 – Annual Energy Consumption per Square Foot

	Consumption per Square Foot (Billing units)	Energy Use Intensity (kBtu/sf)
Electric	15.6 kWh/sf	53.2
Natural Gas	0.34 therms/sf	33.8
Total		**87.0**

Figure 1 – Energy Consumption by Fuel Type

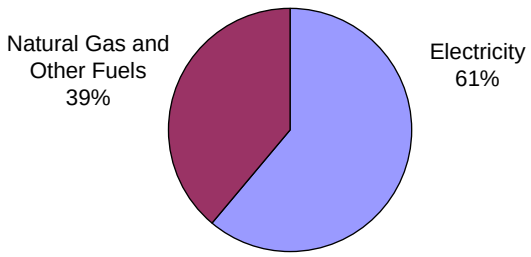
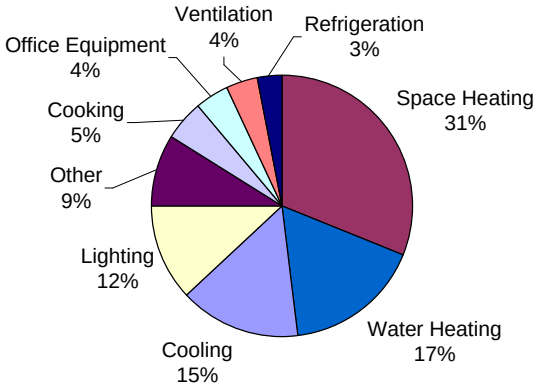


Figure 2 – Total Energy Consumption by End Use
Adapted from E Source, 2006



[1] From PKF Consulting's Hospitality Research Group and personal communications.
[2] 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 hotels 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

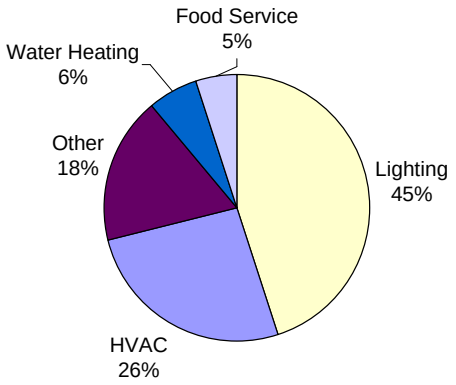
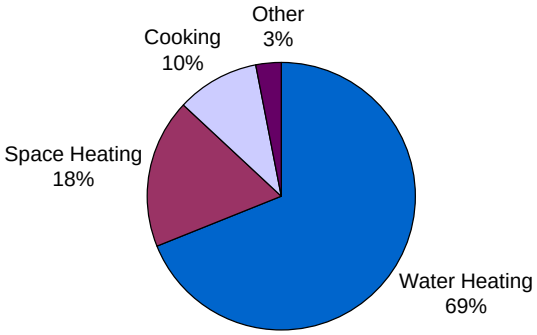


Figure 4 – Natural Gas Consumption by End Use
Adapted from EEI, 2001

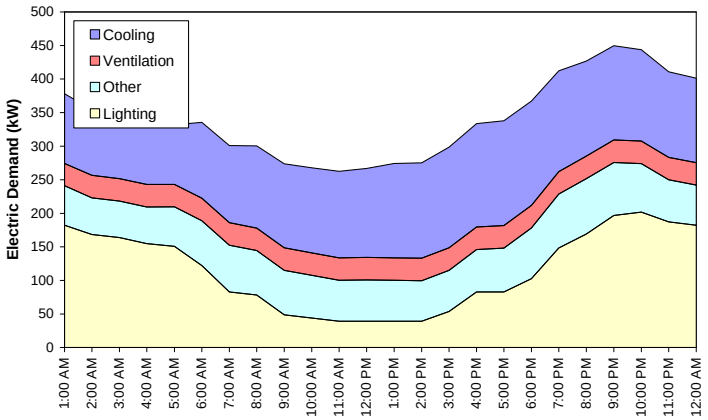


Daily Load Shape

Load Shape – Baseline Scenario: The load profile below represents a baseline scenario for daily operations at a "typical" hotel on a summer weekday[3]. This load profile illustrates the contributions of lighting, cooling, ventilation, and other loads throughout the day. Total building energy consumption in hotels is highest in the evening when most guests are in their rooms. Energy consumption dips down overnight when guests are sleeping, and during the day when guests check out.

Figure 5 - Typical Hotel Load Profile – Baseline Scenario

Assumptions
- High rise hotel
- 180,000 square feet
- Centrifugal chiller / 4-pipe fan coils with hot water heating
- Chicago, Illinois
- Typical summer day



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

[3] 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 in Common Areas
- Optimize HVAC Scheduling in Common Areas
- Demand Controlled Ventilation in Common Areas
- Chilled Water Reset Controls
- Power Management Enabling for PCs, Printers, and Copiers
- Turn off Plug Loads at Night
- Towel and Linen Re-use Programs
- Specify ENERGY STAR Equipment – Vending, Refrigerators, TVs, Commercial Food Service Equipment

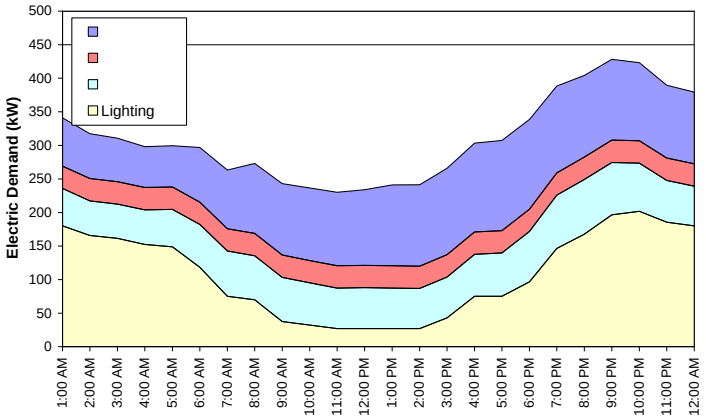


Figure 7 – Load Profile with Lighting Measures

Measure List

- Efficient Lighting (CFLs, High Performance T8s, LED Exit Signs)
- Occupancy Sensors (back rooms)
- Night Lights in Guest Rooms

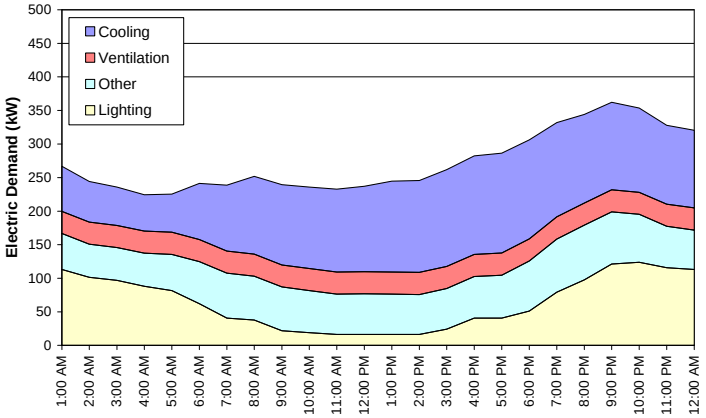
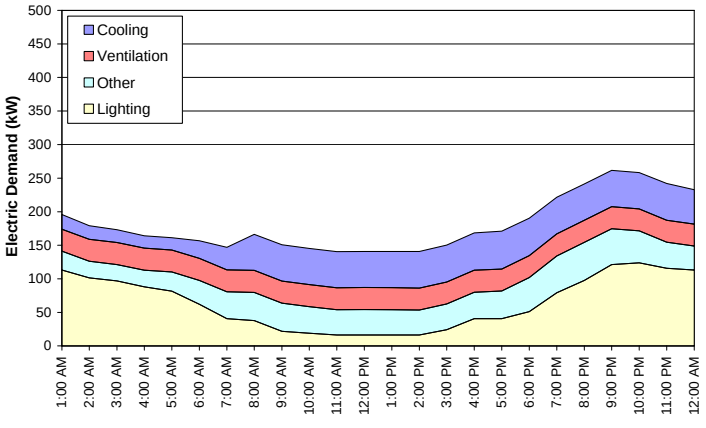


Figure 8 – Load Profile with All Measures

Measure List

- Includes all O&M / Re-commissioning measures
- Includes all Lighting measures
- High-Efficiency Chillers
- Variable Speed Pumps and Fans
- Premium Efficiency Motors
- Occupancy Based Guest Room HVAC and Lighting Controls



The load profile after the implementation of operations and maintenance measures shows savings for all end uses throughout the day, due to a combination of controls adjustments and the specification of ENERGY STAR equipment. The lighting measures result in savings throughout the day as a result of more efficient lighting technologies, including many in areas of 24-hour operation, and savings during mid-day and overnight from lighting controls. 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 chillers, variable speed drives, and guest room controls. The total reduction in peak demand for this building on a typical summer day is 188 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 23 kBtu per square foot, or 22% of the baseline. This translates to $108,720 per year at national average utility rates of $0.094 per kWh and $1.16 per therm[4].

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 48[5]. Factoring in the hypothetical energy efficiency measures that were applied to this building, the energy performance rating increased to 91.

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	2,482,000	--	--	102,300	--	--	104	--
O&M	2,224,000	258,000	10%	91,800	10,500	10%	93	**10%**
Lighting	1,967,000	515,000	21%	114,600	-12,300	-12%	101	**3%**
All Measures	1,376,000	1,106,000	45%	98,200	4,100	4%	81	**22%**

Scenario	Peak Demand (kW)	Demand Reduction (kW)	Demand Reduction (%)	Energy Cost ($)	Energy Savings ($)	EPA Energy Rating
Baseline	450	--	--	$351,976	--	**48**
O&M	424	26	**6%**	$315,544	**$36,432**	**64**
Lighting	362	88	**19%**	$317,834	**$34,142**	**65**
All Measures	262	188	**42%**	$243,256	**$108,720**	**91**

[4] Based on Energy Information Administration data for 2006.
[5] Assumptions entered into Portfolio Manager include a space type of Upscale Hotel with 180,000 square feet, 200 guest rooms, and the presence of a food preparation facility.