



Improving the Energy Efficiency of Food Service Facilities

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Presentation Overview

- Types of Food Service Facilities
- Operating Costs & Energy Usage
- End-Use Energy Consumption
- Types of Equipment Used
- Energy-Efficiency Measures
- AFB Case Study of Food Service Facilities
- LEED & Food Service

Definitions

Energy Usage Index (EUI): method of benchmarking similar facilities to determine relative building efficiency and potential for energy conservation.

EUI = kWh/sq.ft-year (electric only) or
kBtus/sq.ft-year (multiple fuel sources)

Cost Utilization Index (CUI) is a measurement of the relative cost per square foot (\$/sq.ft-year). (The higher the CUI, the more expensive it is to operate.)

More Definitions

End-use: the type of equipment energized to provide a necessary food service function (cooking, air conditioning, refrigeration)

EEMs & ECMs (energy-efficiency measures and energy-conservation measures): methods to reduce energy consumption.

Energy consumption: generally defined in terms of kWh/year, kBtus/year or MMbtus/year (millions of BTUs/year)

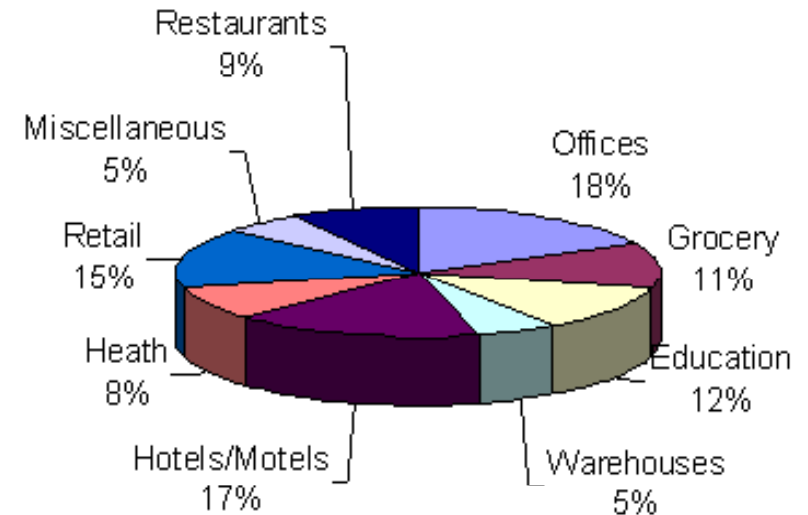
Factors Affecting EUI & CUI

Various factors affect EUI and CUI:

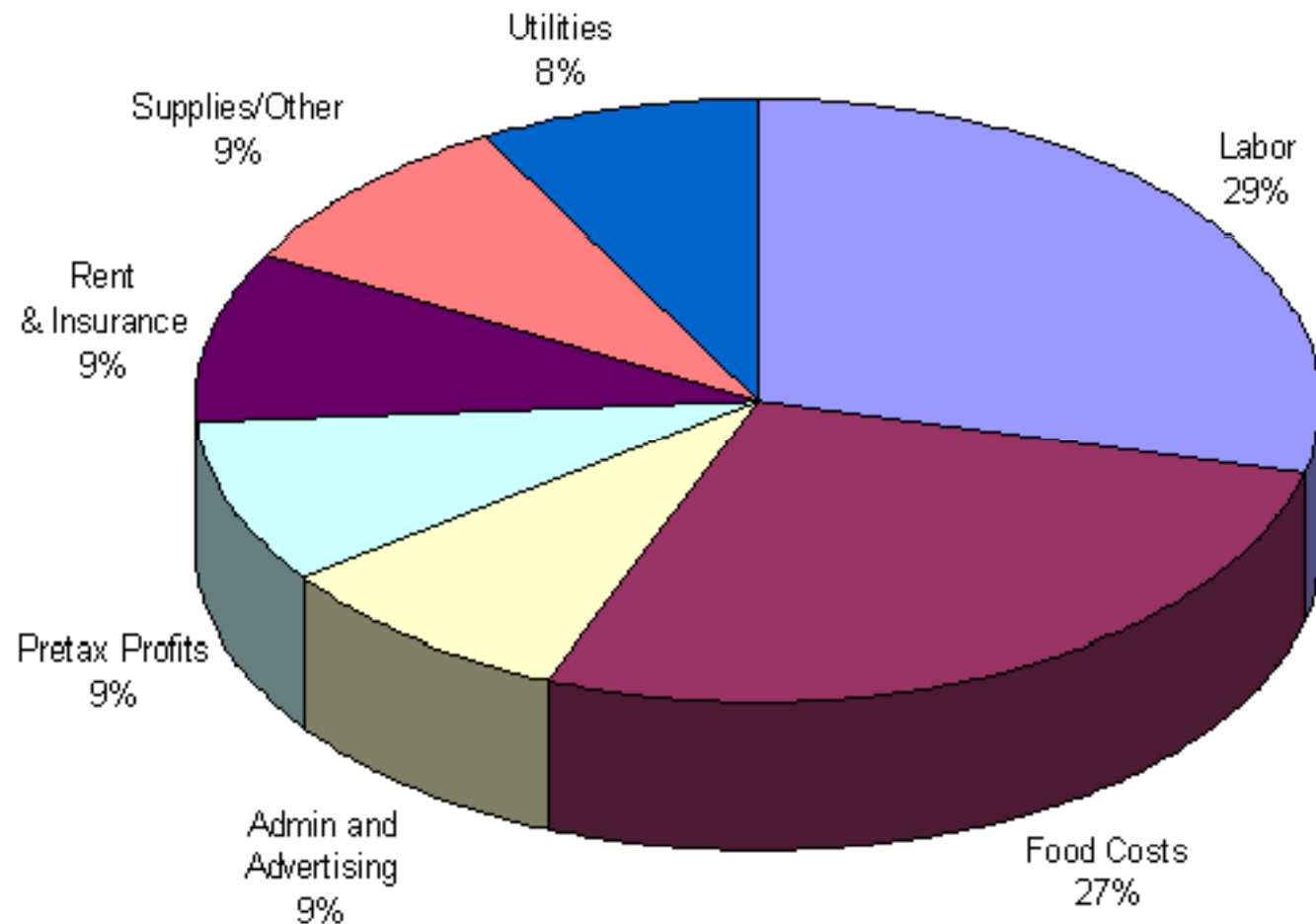
1. **Buildings:** Age of building, operating hours, type of food service facility, meals per day, and weather
2. **Equipment:** Efficiency of energy-consuming equipment including HVAC, lighting, refrigeration, cooking, hot water, etc.)
3. **Operations:** Management and employee awareness of energy management
4. **Utility rates, rebates, and incentives**

7 Types of Food Service Facilities

- Fast Food, Limited Menu
- Fast Food, Extensive Menu
- Restaurant, Coffee Shop
- Restaurant, Cafeteria
- Restaurant, Pizza House
- Restaurant, Dinner House, Limited Menu (Specialty)
- Restaurant, Dinner House, Full Menu



Operating Expenses in Food Service Industry



End Uses

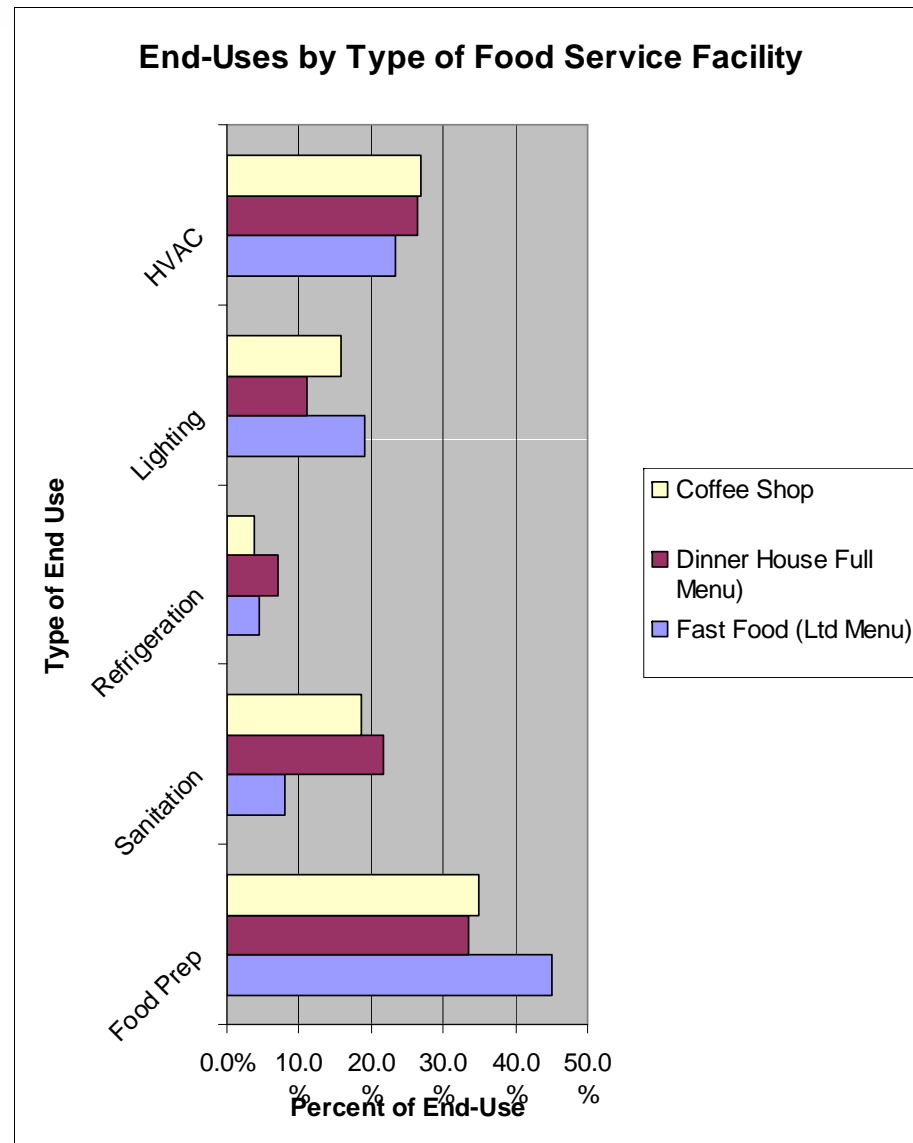
HVAC

Lighting

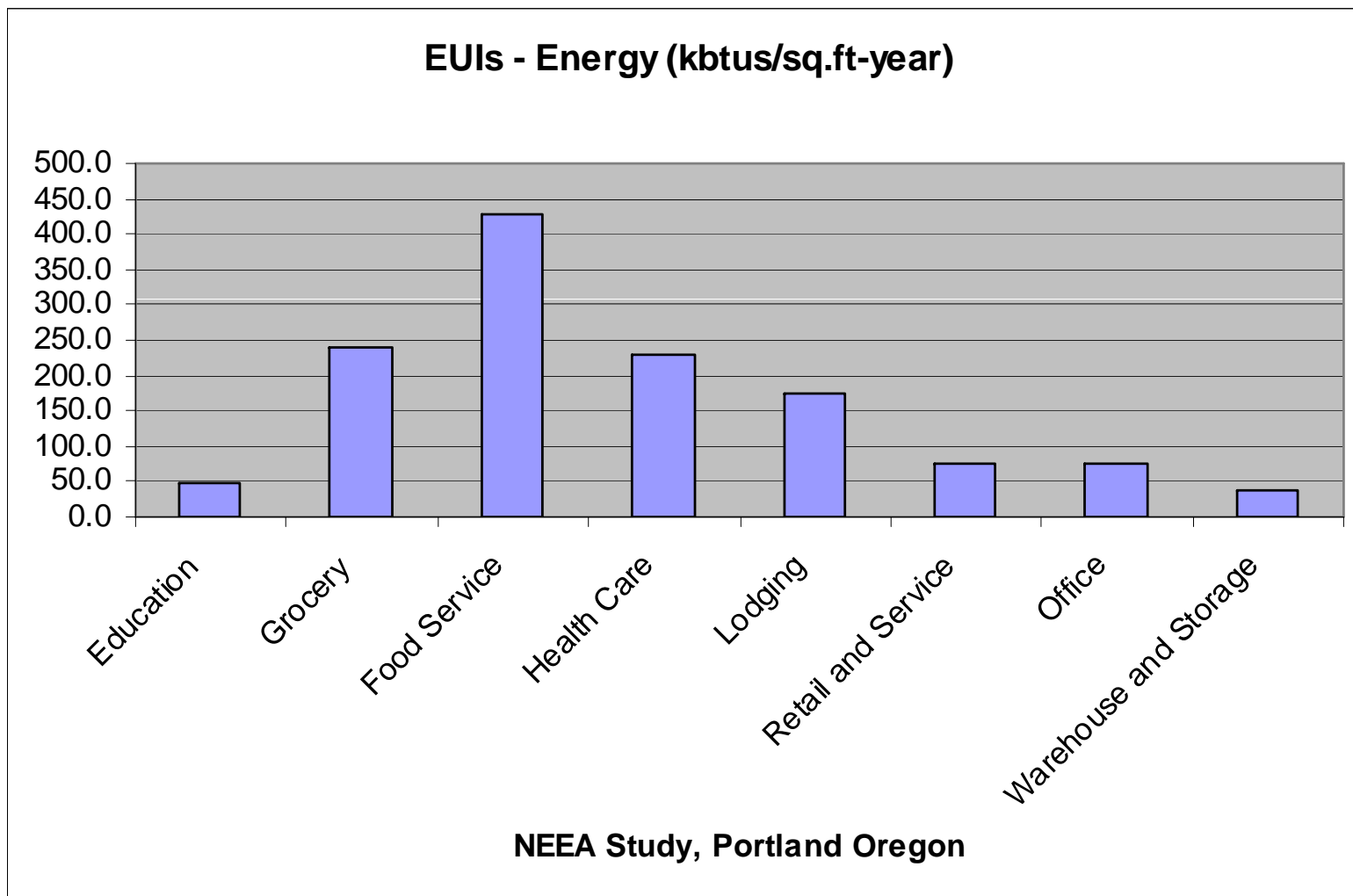
Refrigeration

Sanitation

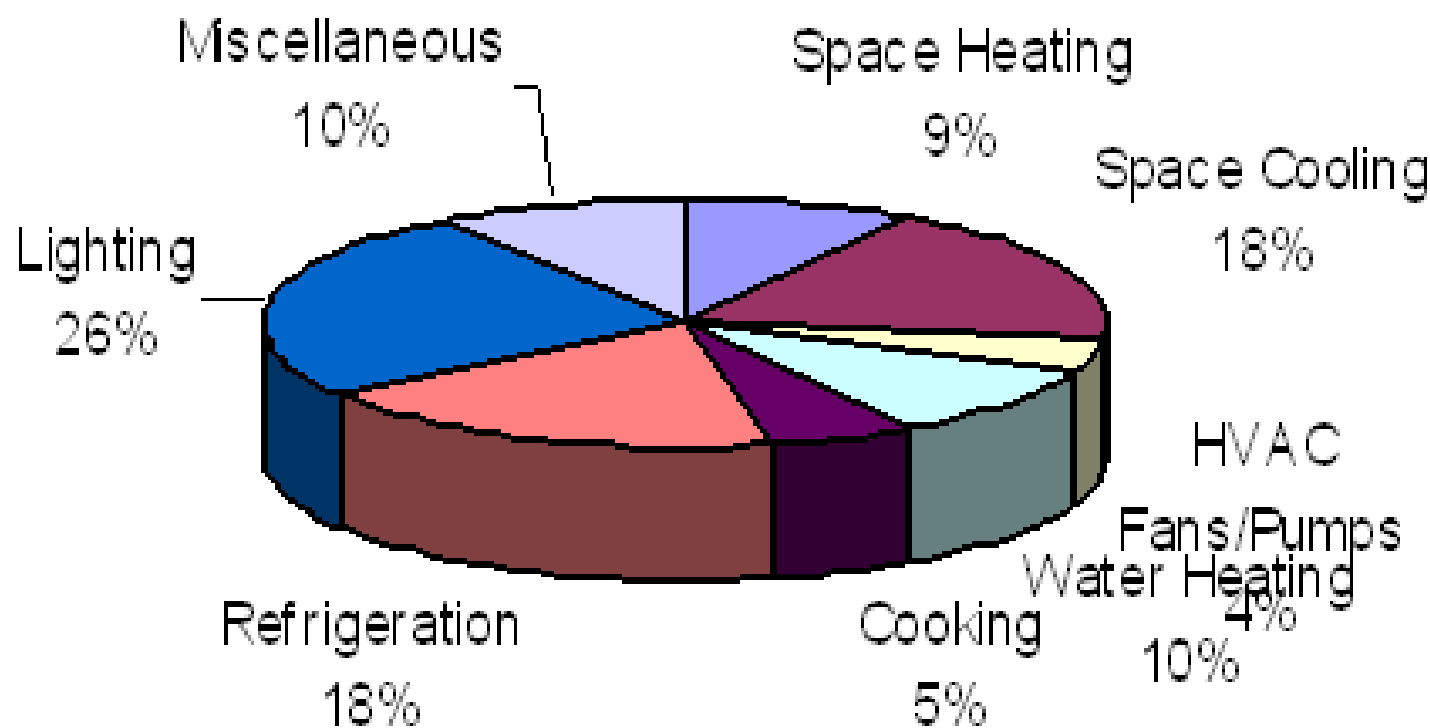
Food Prep



Energy Use Indices (EUIs)



End-Use Energy: ASHRAE Zone 4



Food Service Equipment Types

1. Lighting systems
2. Hot water systems
3. Motors
4. Refrigeration
5. Cooking
6. Heating, ventilating and air-conditioning (HVAC) systems
7. Computers and miscellaneous equipment



Some Energy-Efficiency Measures

Item	Measure
Building Envelope	Additional insulation, high performance windows, daylighting, cool roofs
HVAC	High performance heating and A/C systems, economizers, variable flow exhaust
Lighting	Reduced lighting loads, high performance T8s, LEDs, CFLs
Motors	Premium efficient motors, VFDs (for fans & pumps)
Domestic Hot Water	High-performance water heaters, solar water heating, heat recovery, water source heat pumps, desuperheaters
Refrigeration	High-performance motors and controls, heat recovery, strip curtains, energy efficient ice machines
Miscellaneous	High-performance cooking equipment, reduced office equipment loads
Renewable Energy	PV, wind, geothermal, biomass

Case Study

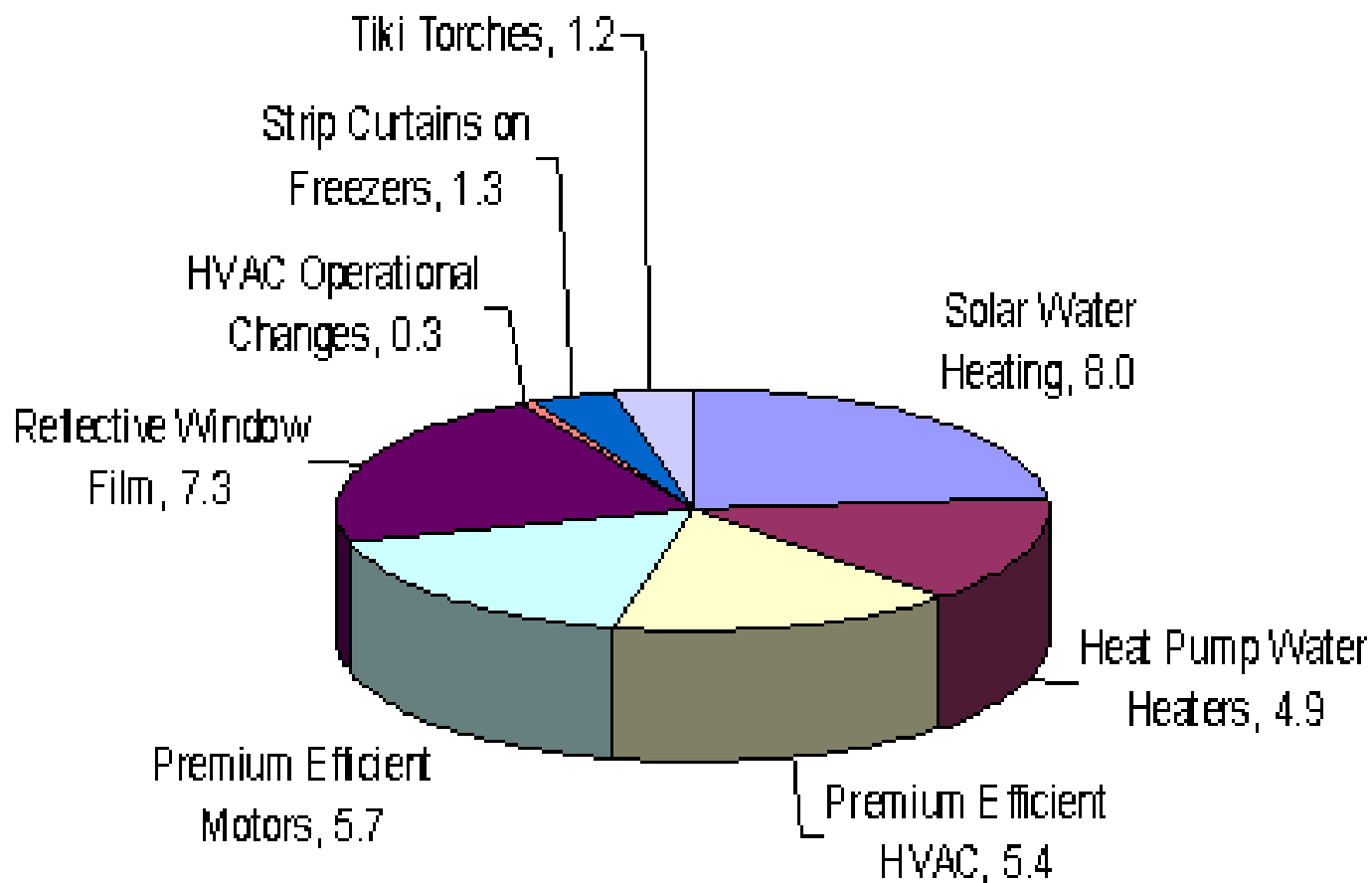
Case Study: Air Force Base

OVERVIEW

- Operating costs = \$500,000 per year
- 6 food Service Buildings
- 46,000 Sq. Ft.
- 2.3 million kWh/year
- 52,000 therms/year
- EUI = 308 kBtus/sq.ft-yr.
- CUI = \$11/sq.ft-yr



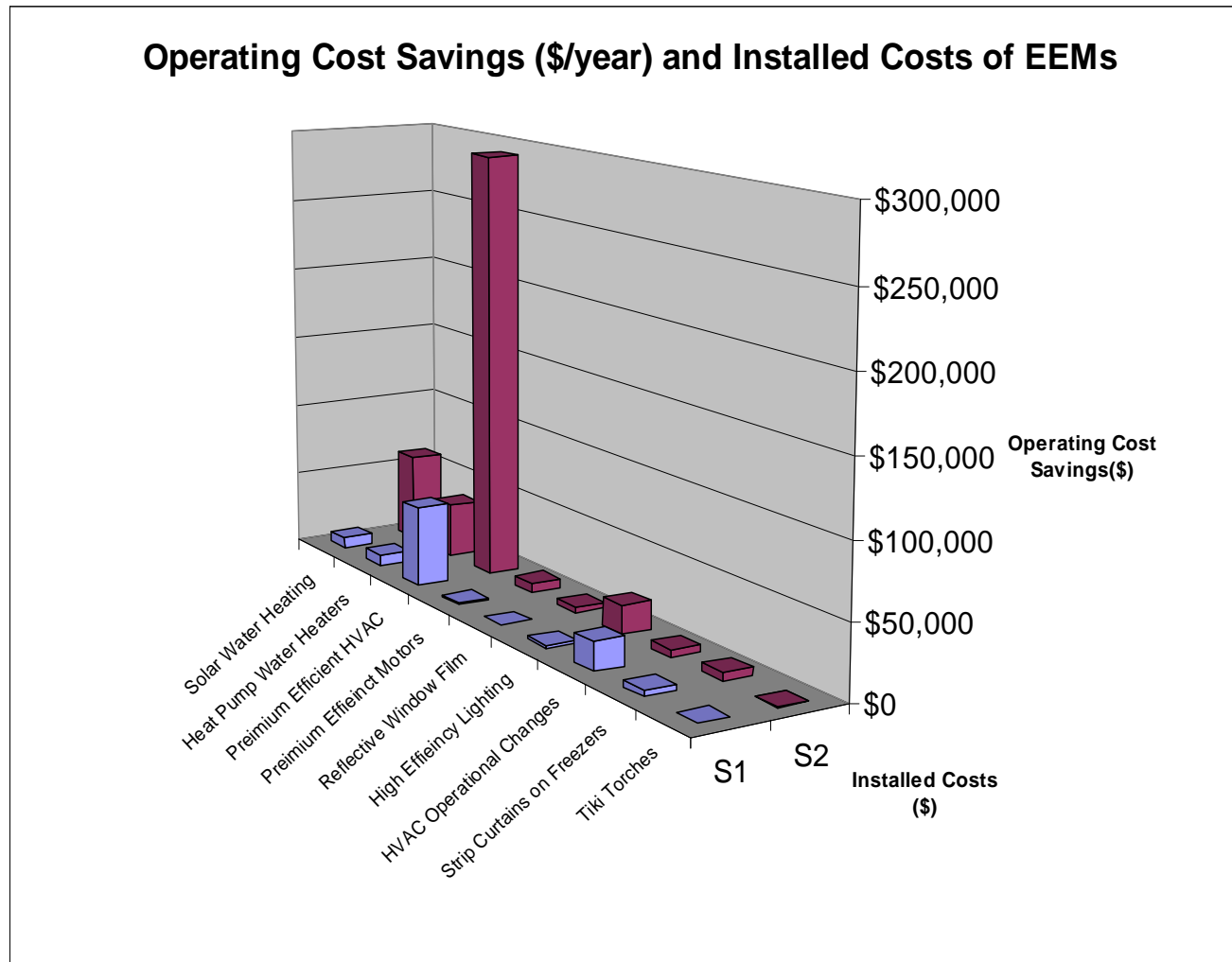
Case Study: Paybacks by Measure Type



Case Study: Total of ECMs

ECM Description	Annual Savings (MMBtu/year)	ECM Savings	Dollar Savings (\$/year)	ECM Cost (\$)	Simple Payback (Years)
Solar Water Heating	295.3	3,210 gallons/year	\$7,488	\$60,245	8.0
Heat Pump Water Heaters	277.1	81,190 kWh/year	\$7,398	\$36,544	4.9
Preimum Efficient HVAC	548.3	160,650 kWh/year	\$54,084	\$291,940	5.4
Preimum Effieinct Motors	25.8	7,559 kWh/year	\$1,135	\$6,524	5.7
Reflective Window Film	12.2	3,579 kWh/year	\$537	\$3,937	7.3
High Effieincy Lighting	42.8	12,540 kWh/year	\$1,882	\$19,398	10.3
HVAC Operational Changes	441.3	129,300 kWh/year	\$19,395	\$5,034	0.3
Strip Curtains on Freezers	91.5	26,809 kWh/year	\$4,315	\$5,720	1.3
Tiki Torches	11.5	125 gallons/year	\$294	\$358	1.2
Total	1745.8		\$96,528	\$429,700	4.5

Case Study: Operating Cost Savings and Installed Costs



LEED & Food Service Facilities

LEED Points

Description	LEED Points
Sustainable sites	26
Water efficiency	10
Energy & atmosphere	35
Materials & resources	14
Indoor environmental quality	15
Innovation & design process	6
Regional priority credits	4
<i>Total Possible Points</i>	110

- Certified 40-49 points
- Silver, 50-59 points
- Gold, 60-79 points
- Platinum, 80-110 points

LEED Projects in Food Service

- Only 7 restaurant structures have met the LEED benchmark to date
(January 4, 2010, QRS Magazine)
- The proposed changes to USGBC LEED Retail rating system (version 3) should make it easier for restaurants
(Ashley Katz, USGBC)

Examples: LEED Restaurant

Chipotle Mexican Grill (Gurnee, Illinois)

- Six kW wind turbine
- Cool roof & rainwater collection system
- High-efficiency appliances
- LED lights

Print Works Bistro (Greensboro, North Carolina)

- Natural daylighting
- Energy recovery systems
- Solar roof water-heating system
- local building materials

LEED Points: HVAC

Examples of Major Retrofits

- Solar film on west/south exposures, thermal shades
- Apply economizer cycles
- Replace older HVAC with high-performance equipment
- Thermostat upgrades & set-point temperatures
- Two-speed motors or variable speed ventilation hoods.

Examples of New Construction

- Fenestration EEMs
- Additional insulation in applicable climates
- High-efficiency HVAC equipment
- Thermostat controls
- Desuperheaters for HVAC

LEED Points: Lighting and Hot Water

Retrofit

- Replace less efficient-light sources
- Reduce operating times as feasible
- Reduced set point temperature for DHW
- Preheat hot water (including solar water heating)
- Chemical dishwashers systems

New Construction

- Reduce power lighting densities to below code
- Use high-performance CFLS and automatic lighting controls
- Use occupancy sensors for bathrooms & storage rooms
- Use hot water heat recovery systems

LEED Points: Cooking & Refrigeration

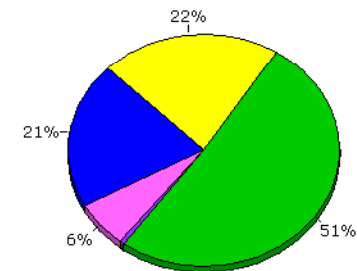
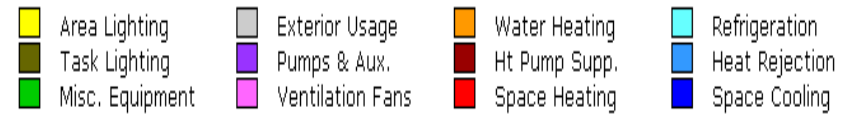
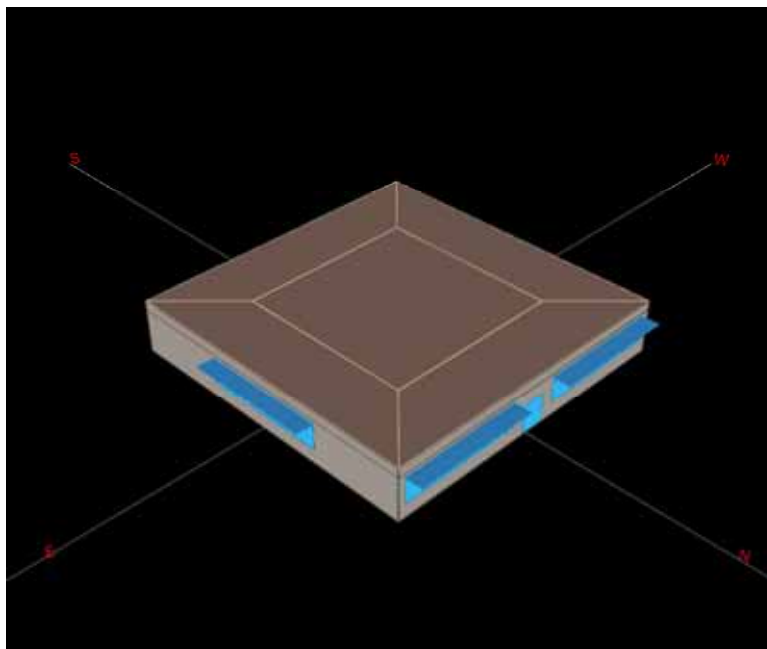
Retrofit

- Replace cooking equipment with EPA Energy Star equipment
- Reduce cooling equipment run times (educate staff)
- Reduce cooking temperature setpoints
- Insure minimum refrigeration temperatures are maintained
- O&M - Keep condenser and evaporator coils clean

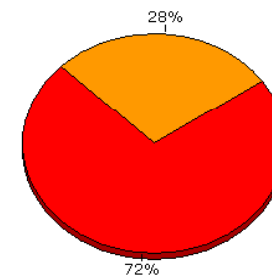
New Construction

- Install EPA Energy Star-approved cooking equipment
- Reduce ventilation loads with more efficient or gas cooking equipment (ventilation requirements 2 CFM linear foot for electric)

LEED Example – DOE2 Model



Electricity



Natural Gas

DOE2 Results of EEMs

ENERGY SAVINGS RESULTS	Baseline	High Eff A/C	High Eff Furnace	High Eff LTG	DHW ECM	All ECMs
Total All Loads (MMbtus/year)	911	885	882	861	863	759
Energy Usage Index (EUI), kBtus/sq.ft-yr.	182.1	177.1	176.4	172.1	172.7	151.8
Cost Utilization Index (CUI)	\$3.44	\$3.32	\$3.37	\$3.14	\$3.33	\$2.86
OVERVIEW - RESULTS						
Energy savings (\$/year)		\$592	\$315	\$1,501	\$519	\$2,896
Savings by End-Use Load (Percent)		21%	12%	49%	51%	N/A
Total Energy Usage Savings (Percent)		3.4%	1.8%	8.7%	3.0%	16.8%

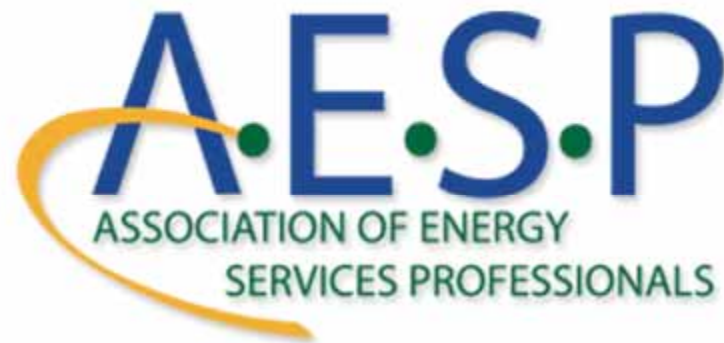
LEED: Most Favorable Technologies

Applicability of LEED points are relative to climate, culture and costs of EEMs

- Variable flow exhaust system
- High-efficiency cooking equipment
- Heat recovery systems
- High-performance HVAC, lighting, & domestic hot water systems;
- High-performance envelope construction, including cool roofs, daylighting, high performance windows.
- Solar water heating & other renewable technologies
- Water conservation & reclamation systems
- Building materials and recycling

Summary

- Food service facilities are energy intensive and make up more than 10% of commercial market.
- Many opportunities to adopt energy efficiency and LEED-approved technologies.
- The application of energy-efficient and LEED technologies will be dependant upon type of food service facility, location and climate.



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