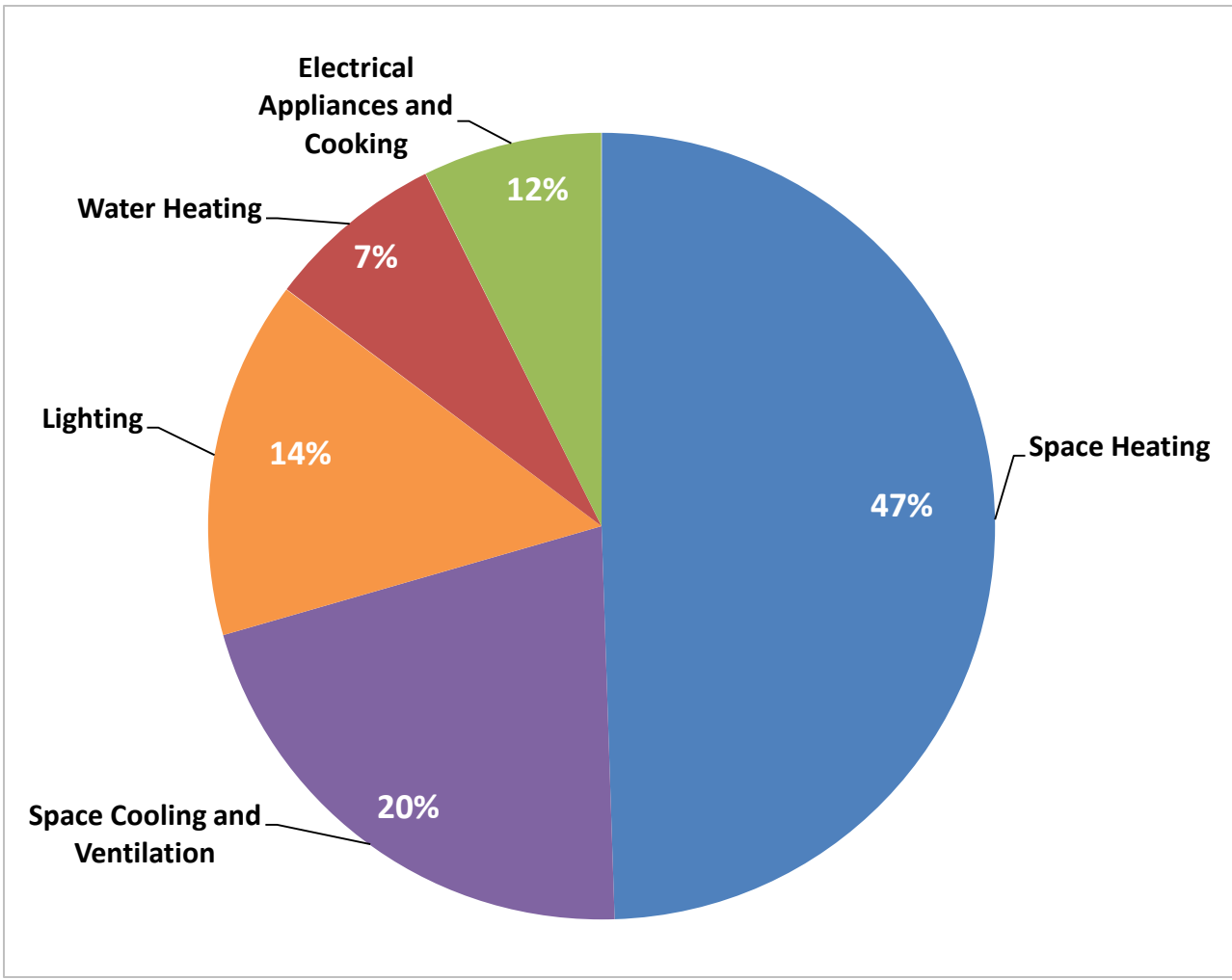


School Building Energy Efficiency Education



Overall Energy Use in Education Buildings



Total - 2003:
240 billion kWh

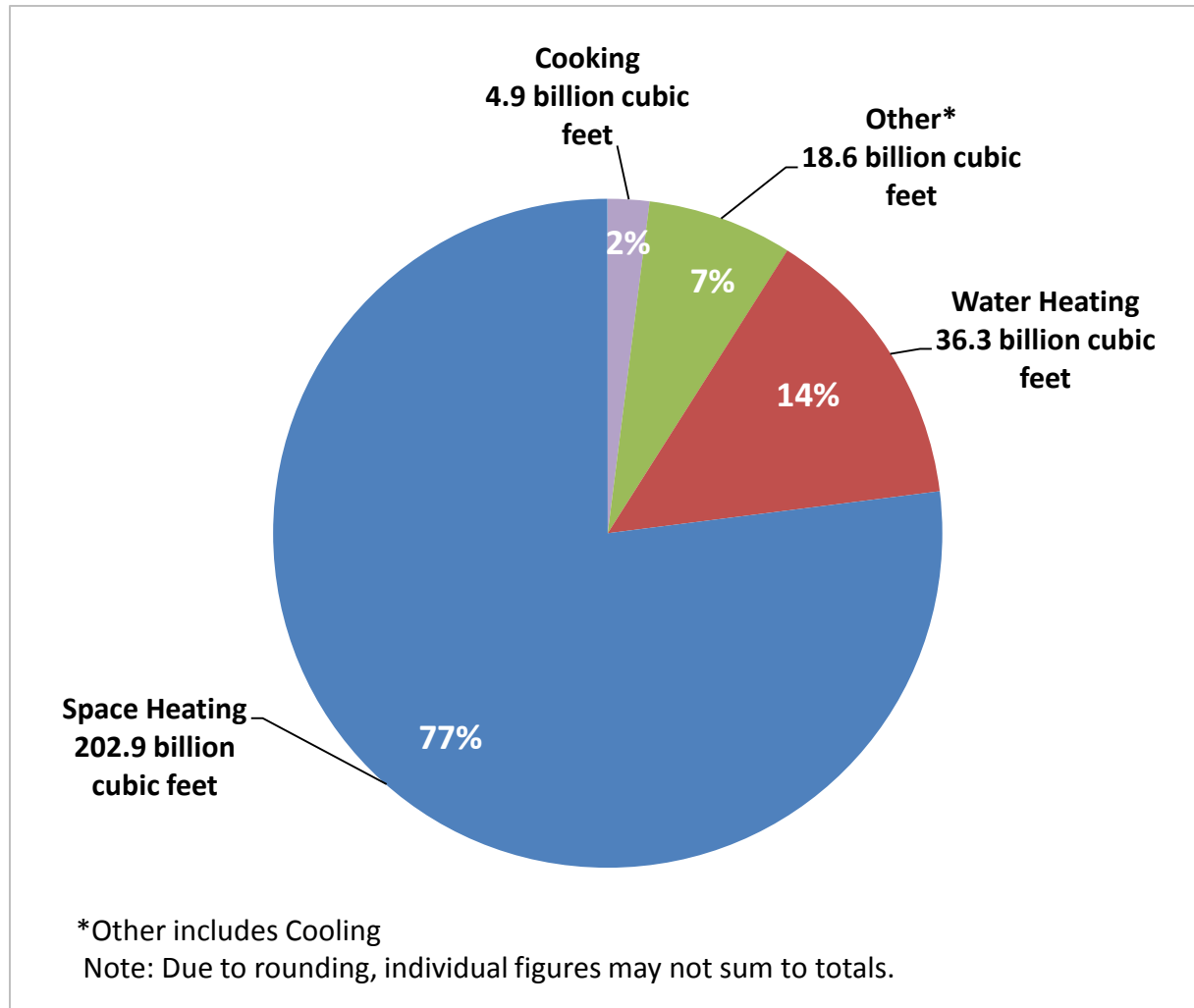
1995:
180 billion kWh

Source:
U.S. Energy Information
Administration,
2003 Commercial
Buildings Energy
Consumption Survey

2012 CBECS data release:
November 2015



Natural Gas Use In Education Buildings



Total - 2003:
263 billion cubic feet

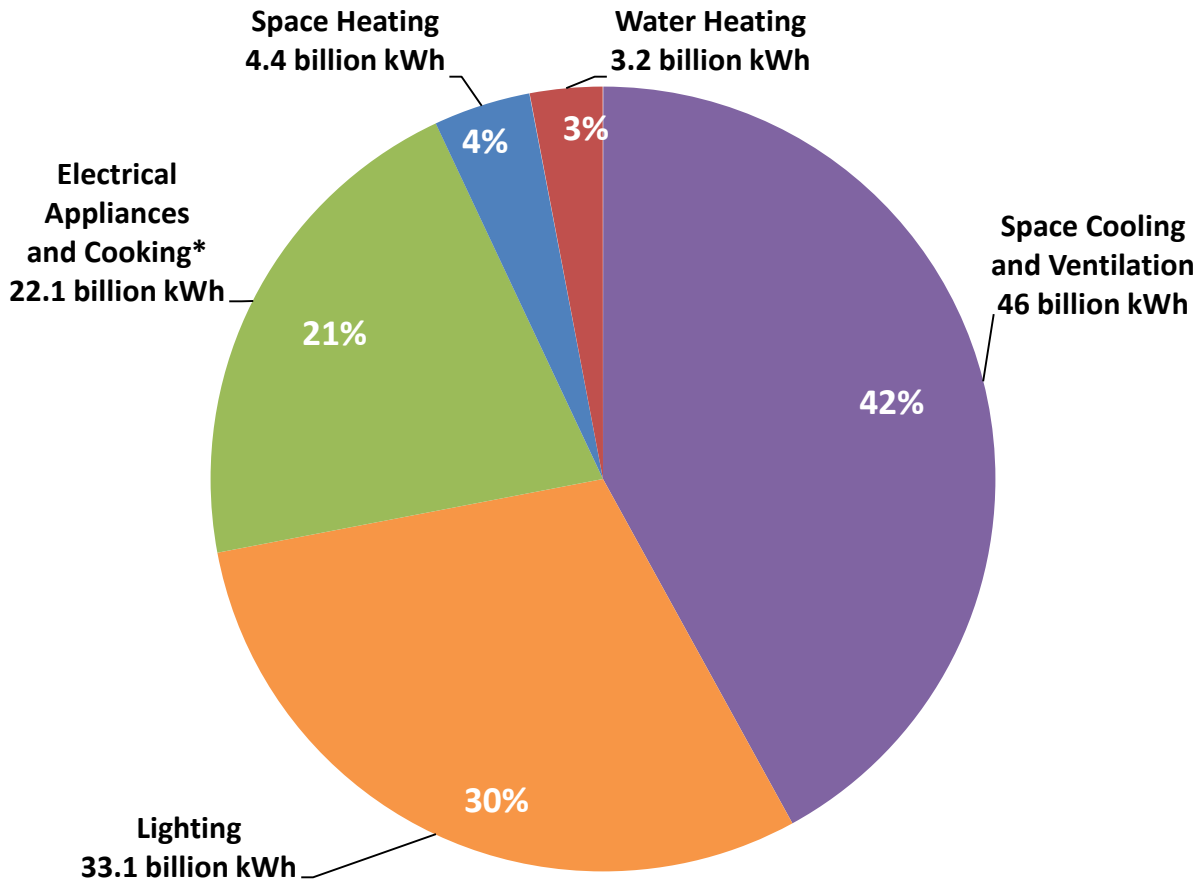
1995:
239 billion cubic feet

Source:
U.S. Energy Information
Administration,
2003 Commercial
Buildings Energy
Consumption Survey

2012 CBECS data release:
November 2015



Electricity Use in Education Buildings



*Electrical Appliances and Cooking includes Computers (9.4 billion kWh), Miscellaneous uses (6.2 billion kWh), Refrigeration (4.7 billion kWh), Office equipment (1.2 billion kWh), and Cooking (0.6 billion kWh). Note: Due to rounding, individual figures may not sum to totals.

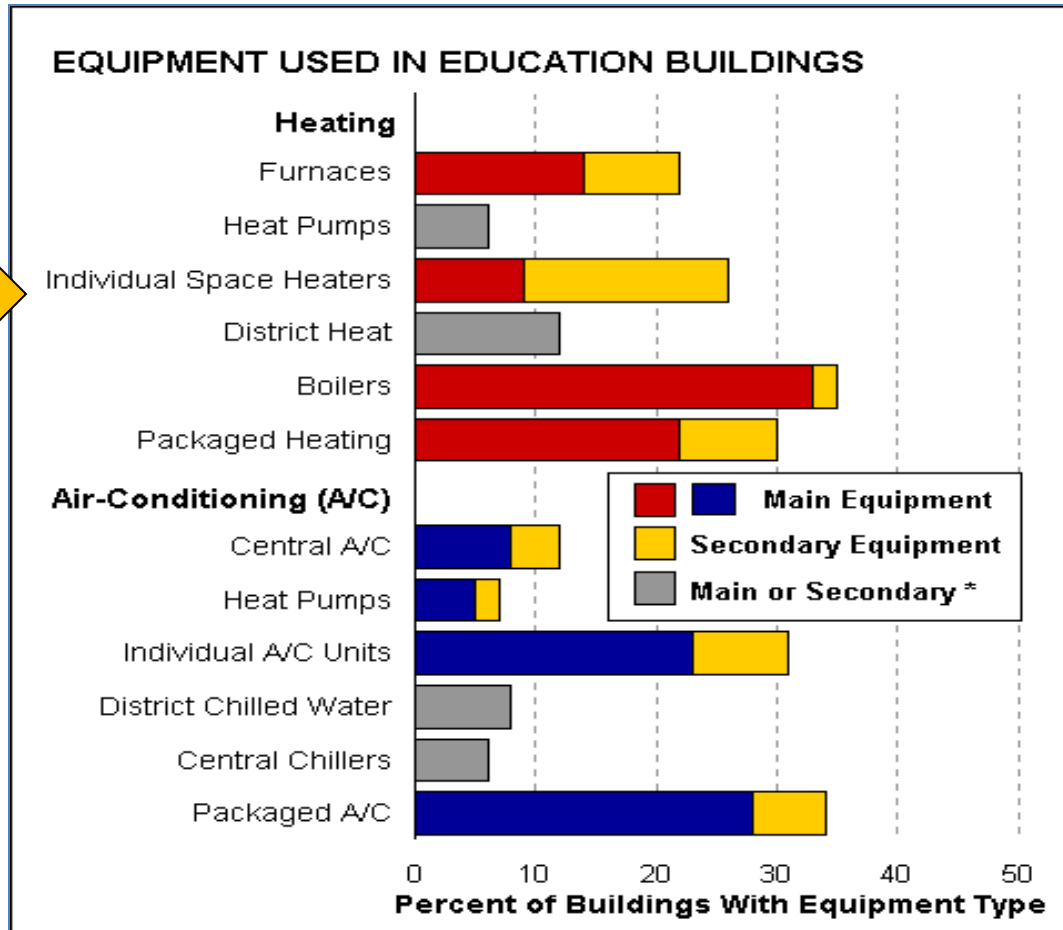
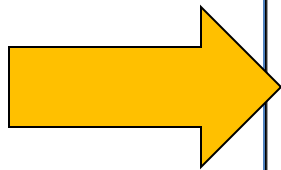
Total - 2003:
109 billion kWh

1995:
65 billion kWh

Source:
U.S. Energy Information
Administration,
2003 Commercial
Buildings Energy
Consumption Survey

2012 CBECS data release:
November 2015

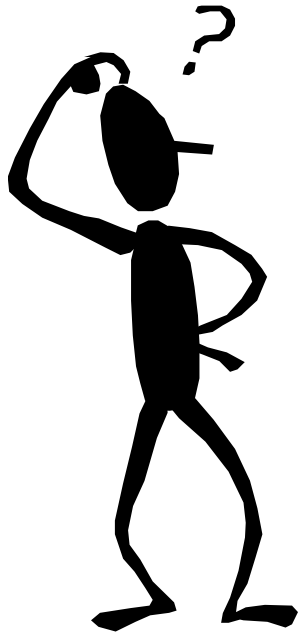
Equipment Used in Education Buildings



Source:
 Department of
 Energy - 1995
 Commercial
 Buildings Energy
 Consumption
 Survey

Energy-Saving Opportunities

*What to
Look For*



- Lighting Opportunities
- Small Appliances/Plug Load
- HVAC Opportunities
- Preventative Maintenance

What is a Foot Candle?

foot-can·dle (f t k n dl) *n.* *Abbr.* fc or ft-c

A unit of measure of the intensity of light falling on a surface, equal to one lumen per square foot and originally defined with reference to a standardized candle burning at one foot from a given surface.



Recommended Light Levels for Schools

Area	Task	Foot Candle Range
Classrooms	Reading printed material	30 - 75 fc
	Writing	50 - 70 fc
	Drafting/accounting/sewing	50 - 150 fc
Gymnasiums	Assemblies	10 fc
	General exercising	30 fc
	Games/matches	30 - 50 fc
Cafeteria	Dining	15 - 50 fc
	Cooking	50 -100 fc
Bathroom	Grooming	20 - 50 fc
	Lavatories	10 - 20 fc
Miscellaneous	Stairways	10 - 30 fc
	Hallways	10 - 20 fc



Energy-Efficient Lamps

Compact Fluorescent & Fluorescent Lamps



Less Efficient Lamps

Incandescent and Metal Halide Lamps



400MH to T8 Fluorescents

- 400watt Metal Halide to 6-Lamp F32 T8 (50% watt reduction)
- Increased light level from 30 to 50 fc, one for one replacement
- From 450 watts to 224 watts; changed from delayed start to instant on
- CRI from 65 to 85, increasing color rendering dramatically



School Gym – HID to HIF

Existing System: 64 fixtures = **29,858 W**

54 400-W HPS – 465W each; six 400W MH – 458W each; four 500W Incandescent night lights

New System: 48-1x8 fixtures = **11,934 W** (60% reduction)

42 4-Lamp T5HO wire grille at 234W; 6 6-Lamp T5HO wire grille at 351W over ball court



Occupancy Sensors

- Controls lighting use in classrooms, offices, halls, storage rooms, and restrooms
- Measures movement of people within a space
- Sensor Costs:
 - About \$30 to replace a light switch
 - Up to \$200 for ceiling/mounted units
- Payback period: 3-6 years



Vending Miser System



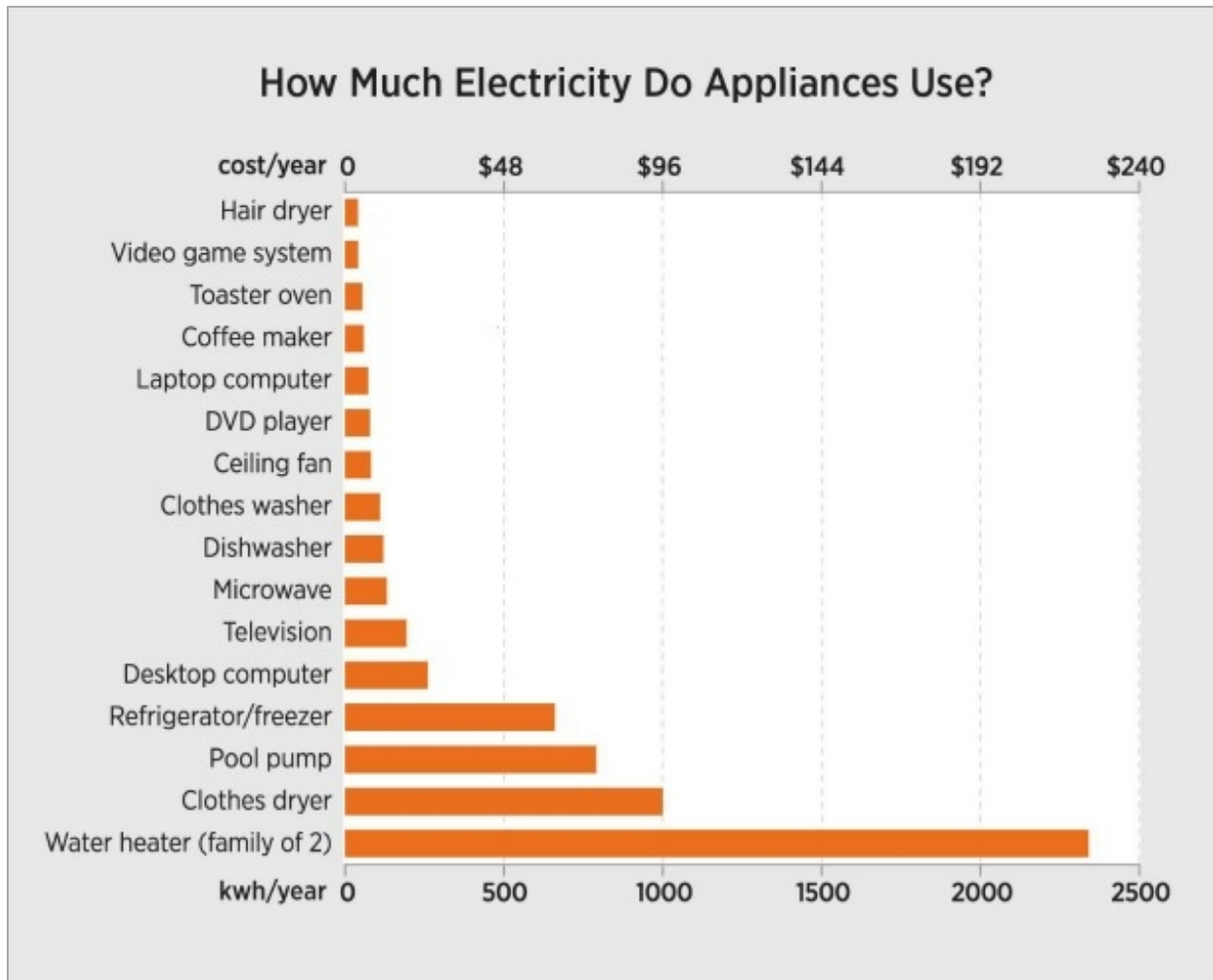
- Vending machines use about \$380 of electricity annually
- Vending Misers can cut energy consumption in half
- Cost is about \$165; payback is less than 2 years
- Tested by Coca-Cola and Pepsi: The system had no adverse impacts on product quality or the vending machine.

Small Appliances / Plug Load

Appliance	Time in use	Kilowatt/hours used per year	Cost per Year
Aquarium	24 hours/day	700	\$70.00
Clock	24 hours/day	36	\$3.60
Clock radio	24 hours/day	44	\$40
Coffee maker	30 minute/day	128	\$12.80
Computer	4 hours/day	520	\$52.00
Dehumidifier	12 hours/day	700	\$70.00
Box Fan	4 hrs/day, 180 days/yr	144	\$14.40
Heater (portable)	3 hours/day, 120 days/yr	540	\$54.00
Microwave over	2 hours/week	89	\$8.90
Radio (stereo)	2 hours/day	73	\$7.30
Refrigerator (small, dorm size)	24 hours/day	340	\$34.00
Refrigerator (frost-free 16 cubic feet)	24 hours/day	642	\$64.20
Refrigerator (frost-free 18 cubic feet)	24 hours/day	683	\$68.30
Television (color)	3 hours/day	264	\$26.40
Toaster oven	1 hour/day	73	\$7.30
VCR	4 hours/day	30	\$3.00



How Much Electricity Do Appliances Use?



This chart shows how much energy a typical appliance uses per year and its cost based on national averages.

For example, a refrigerator/freezer uses almost five times the electricity the average television uses.

Source:
U.S. Department of Energy, 2014

Energy Use of Computers

- Average computer uses 165 watts or .165 kilowatts/hr
 - On Peak Rate: 4.232¢/hr; Off Peak Rate: 2.942¢/hr
- Computers left on most school days and weekends
- 80% turned off during vacations

178 School Days =\$25

76 Vacation Days (20%
of Fleet on) =\$2

52 Weekends (75%
of Fleet On) =\$9

7 Holidays (20% of
Fleet on) =20¢

1 computer costs \$36.20

2900 Computers Cost \$104,980



Efficient Computer Operation

- 99% of fleet turned off from 8:30 pm to 7 am
- 90% of fleet turned off during vacation days
- 99% of fleet turned off during weekends and holidays
- Estimated annual savings = **\$55,303**

178 School Days =\$16

76 Vacation Days (10%
of Fleet on) =\$1

52 Weekends (1%
of Fleet On) =12¢

7 Holidays (1% of
Fleet on) =1¢

1 computer costs
\$17.13

2900 Computers Cost \$49,677

HVAC Opportunities

(Heating, Ventilation, and Air Conditioning)

Boiler Type

Air Handling Units

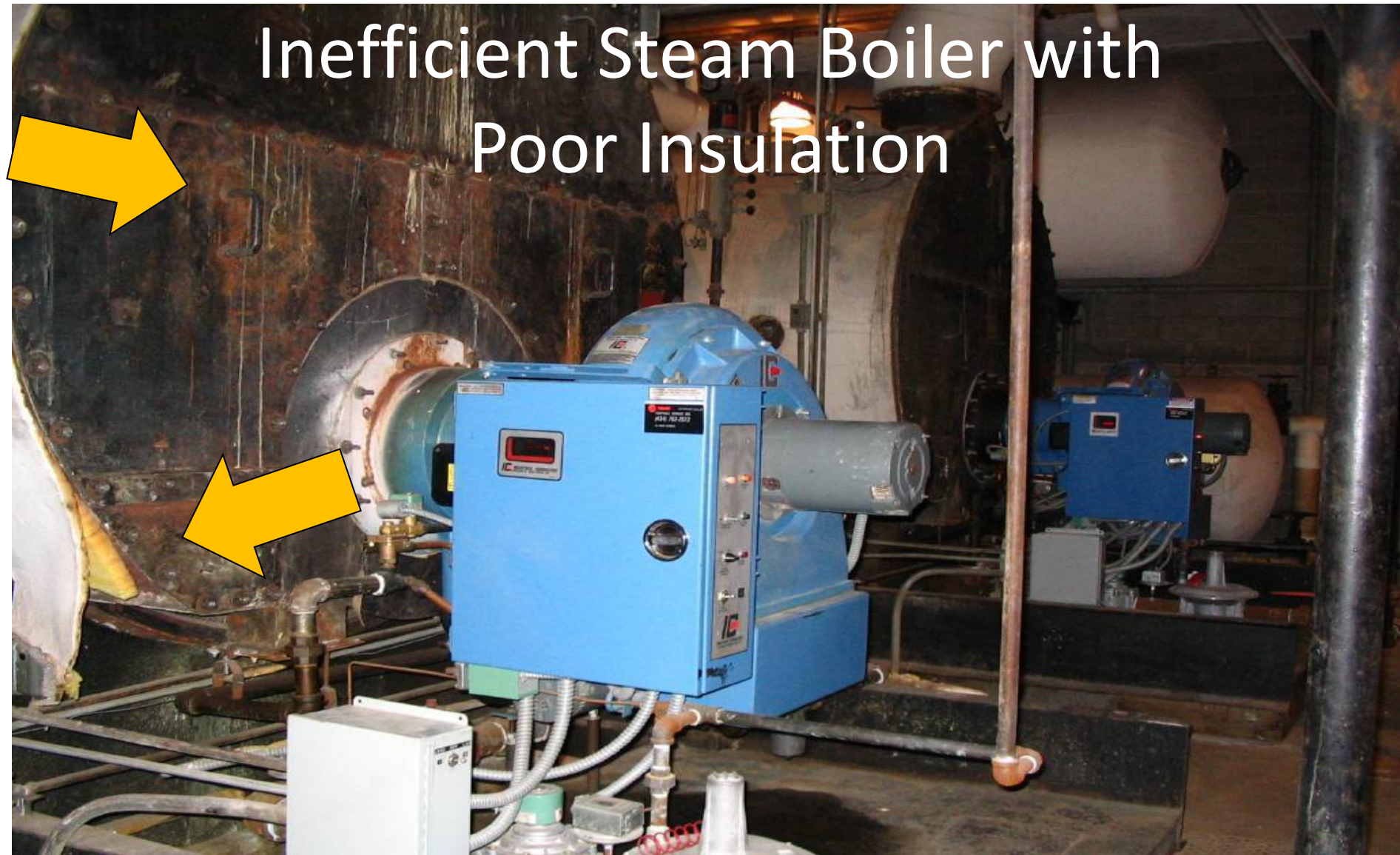


Heat Generation

- Typically steam or hot water is moved throughout the building
- **Hot water boilers are more efficient than steam systems**
- Hot water systems offer greater control:
 - In hot water systems, water temperature is adjusted based on outdoor air temperature
 - In steam systems, heat output is constant whether outdoor air temperature is 40 degrees or 10 below zero



Inefficient Steam Boiler with Poor Insulation

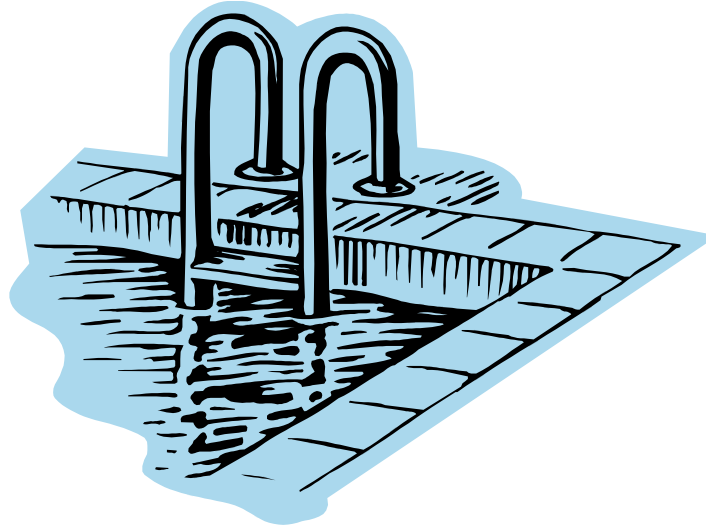


Air Handling Units and Filters



Swimming Pool Opportunities

- Pool Cover
- Water Supply



Pool Covers

- Provides insulation and a barrier to reduce heat loss and evaporation, thereby saving energy and chemicals
- Rarely used in school buildings even when available (time, staff, bulky, etc.)



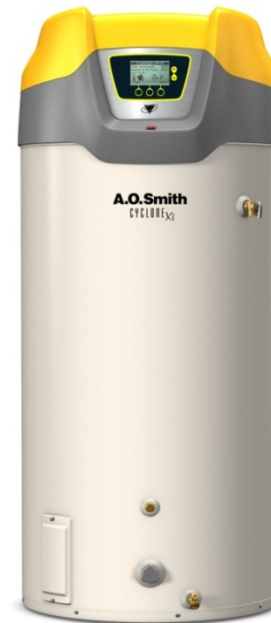
Pool Water Supply



- Apply variable frequency drive (VFD) to pool filtration system
 - Reducing pump speed saves energy
 - An evaluation is recommended prior to installation
- “Throttle” pool circulation pump system
 - Partially closing a shutoff valve on the pump discharge side

Domestic Hot Water

- Check temperature settings
- Large storage tanks are no longer needed



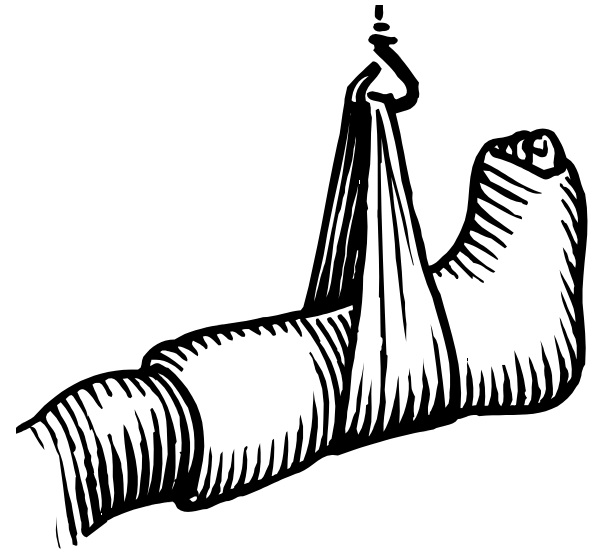
An example
of a 96%
efficient hot
water heater

Maintenance Opportunities

Clean What's Dirty



Fix What's Broken



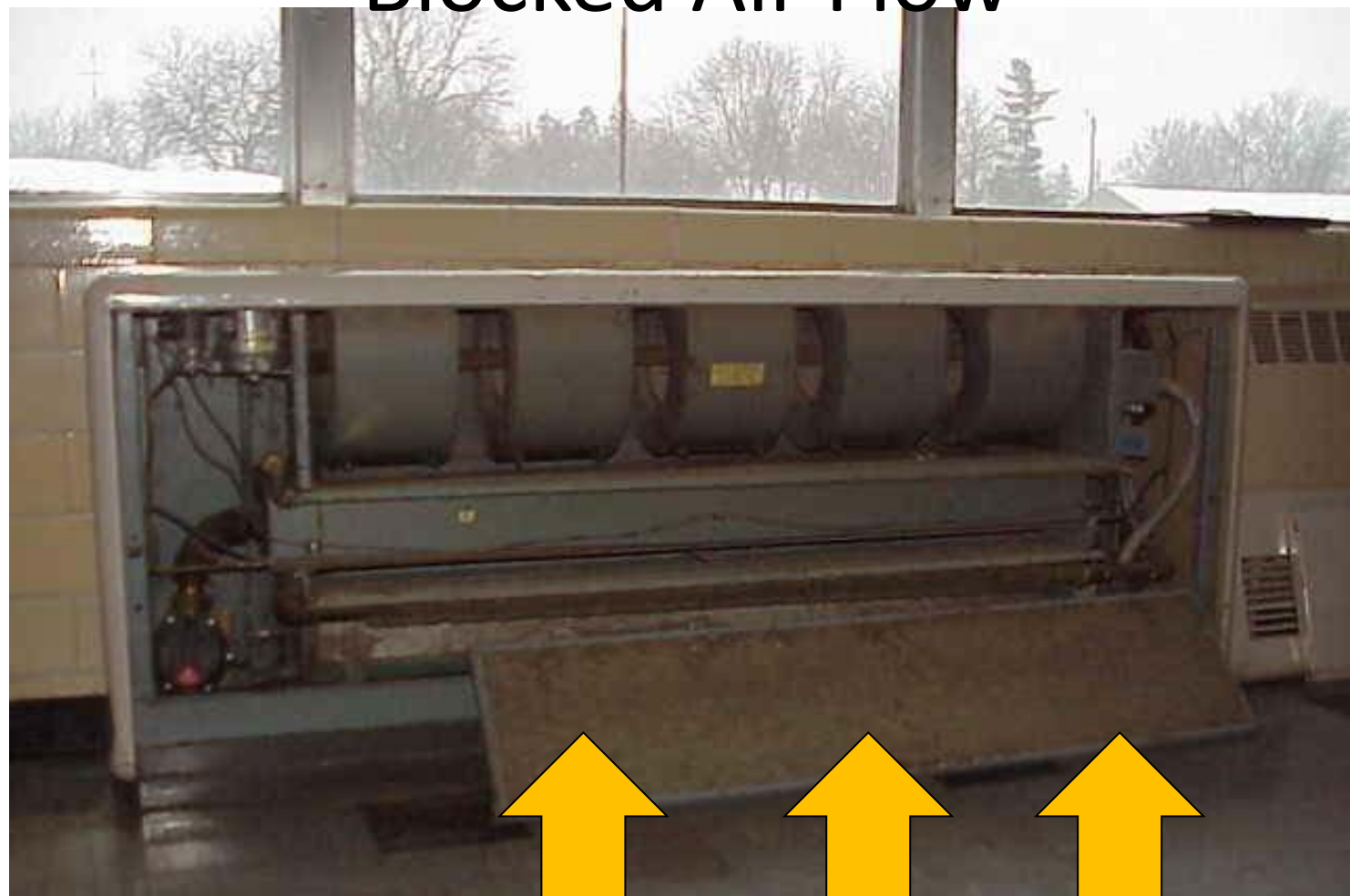
Dirty Circulating Pump - Shortens Equipment Life



Damaged Ceiling Tiles from Leaking Roof - Affects Air Quality



Unit Ventilator with Dirty Filter – Blocked Air Flow



Old Dirty Filters vs. New Filter





Bird nests in outside air intake – potential for Indoor Air Quality problems

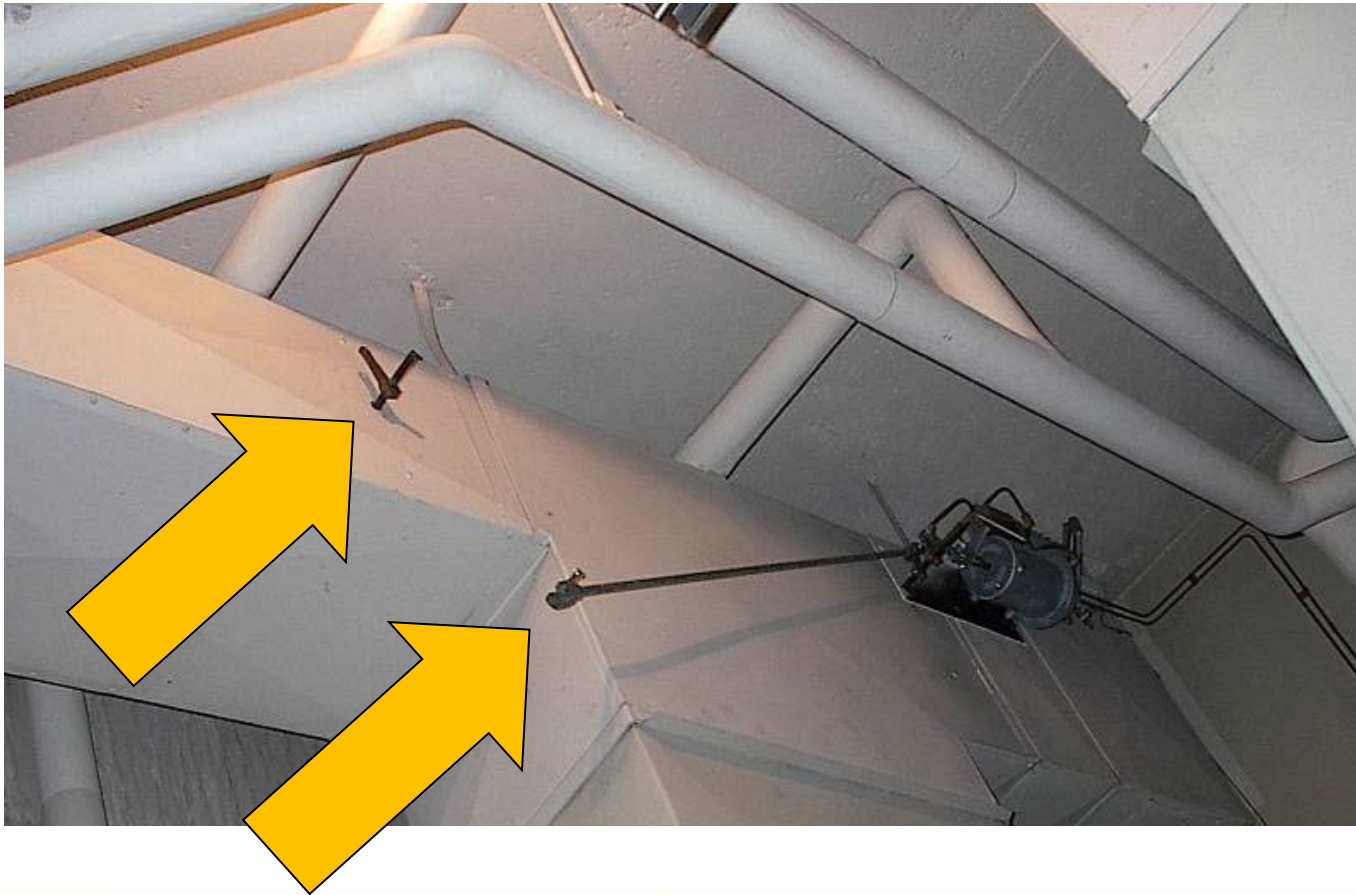




Damaged Weather Stripping



Actuator Disconnected from Damper



Condensate Tank with Leaky Steam Traps



Dampers Propped Open



Valve Leak and Damaged Insulation



Boarded up Outside Air Intakes



Preventative Maintenance is Important



Set Correct Time on Control Units



KEEP's Partners

- Wisconsin Center for Environmental Education
- University of Wisconsin-Stevens Point
- Wisconsin State Energy Office
- Green & Healthy Schools Wisconsin
- College of Natural Resources
- Wisconsin Utilities
- Cool Choices

