

**STOP  
WASTING  
MY MONEY!**

**STASMO  
June 27, 2014**



Reducing Energy  
Costs of Schools

**Brian C. Uhrich, P.E.**  
**LEED AP BD+C, CxA**



8626 Tesoro Drive, Suite 702, San Antonio, TX 78217  
[www.dbrinc.com](http://www.dbrinc.com) 210.546.0200 v 210.546.0201 f

# REDUCING ENERGY COSTS OF SCHOOLS



1. Designing Energy Efficient Schools
2. Commissioning
3. Owner Training
4. Operations & Maintenance
5. Managing Energy Costs
6. Common Energy Pitfalls
7. Low-Cost/No-Cost Energy Saving Strategies

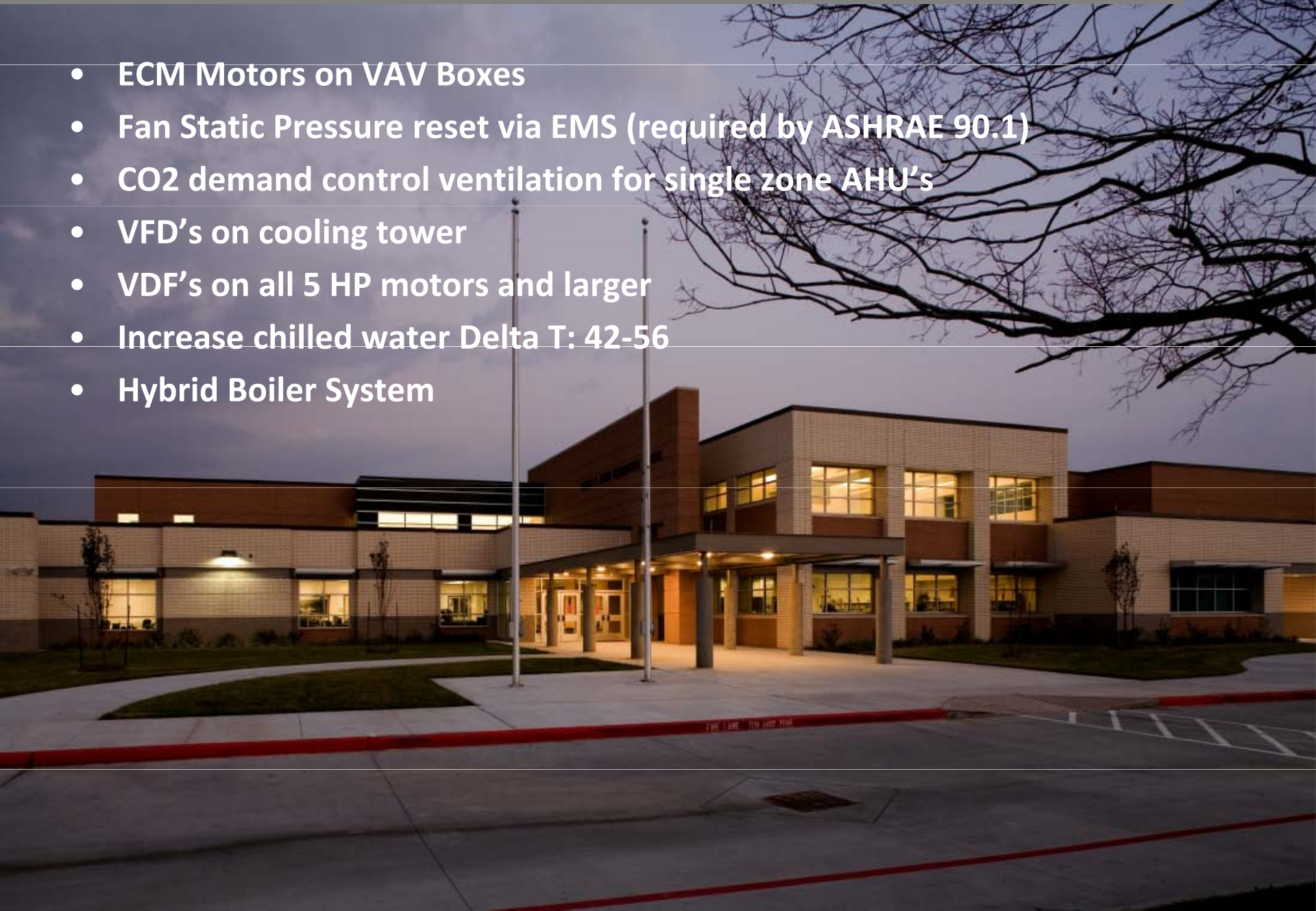
# 1. Designing Energy-Efficient Schools

- Site Orientation
- Efficient building envelope design
- Optimize daylight, minimize solar heat gain
- MEP design strategies



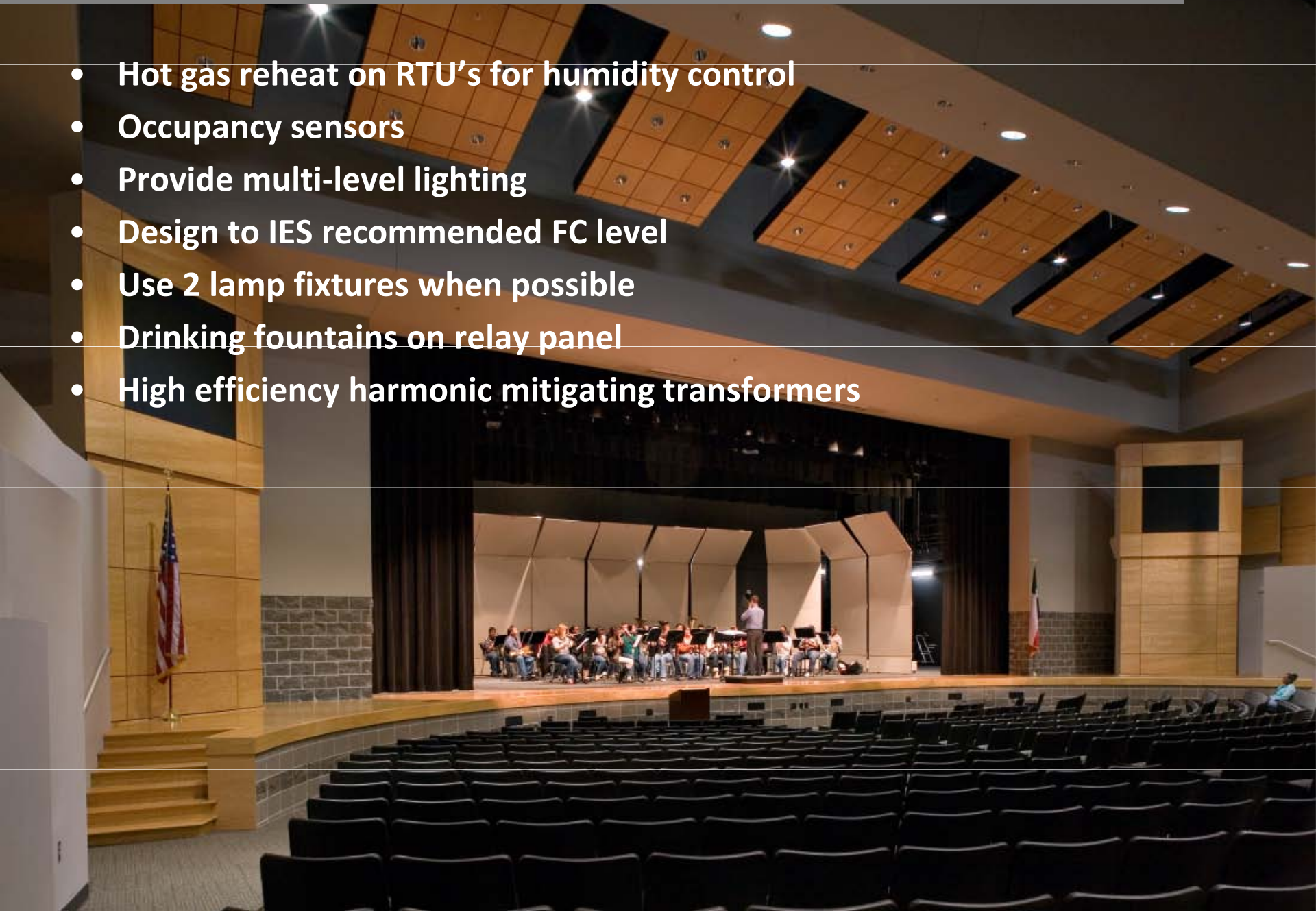
# Standard Cost-Reducing Design Strategies

- ECM Motors on VAV Boxes
- Fan Static Pressure reset via EMS (required by ASHRAE 90.1)
- CO2 demand control ventilation for single zone AHU's
- VFD's on cooling tower
- VDF's on all 5 HP motors and larger
- Increase chilled water Delta T: 42-56
- Hybrid Boiler System



# Standard Cost-Reducing Design Strategies

- Hot gas reheat on RTU's for humidity control
- Occupancy sensors
- Provide multi-level lighting
- Design to IES recommended FC level
- Use 2 lamp fixtures when possible
- Drinking fountains on relay panel
- High efficiency harmonic mitigating transformers



# Recommended Cost-Reducing Design Strategies

# Optional Cost-Reducing Design Strategies

- Provide lower lighting level with task lighting
  - Increase chilled water Delta T: 42-58
  - Low temperature air distribution
  - VDF's on chillers
  - LED lights
  - Geothermal
  - VRF (Variable Refrigerant Flow)
  - Solar Photovoltaic
  - Solar Thermal
  - Other renewable energy
- 



## 2. Commissioning

- Verify proper installation of energy-related systems
- Test to confirm operation
- Prepare a record to assist M&O



### 3. Owner Training

- O&M “Kick-off” Meeting
- Convey design intent, code requirements, important energy-conservation strategies
- Document training to facilitate re-training
- Schedule training at intervals of 3, 6, 9 months
- Offer tune-ups
- Provide resources for future reference

## 4. Maintenance & Operations



- Single most important factor in energy performance of any building
- Scheduling, set points
- Preventative maintenance

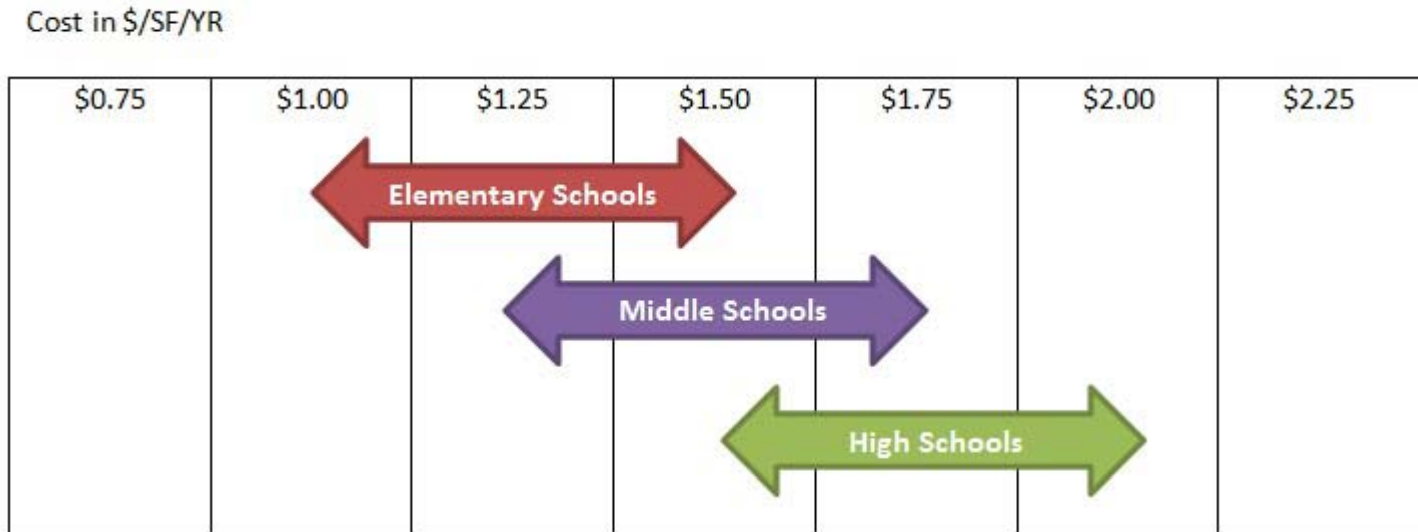
# 5. Managing Energy Costs



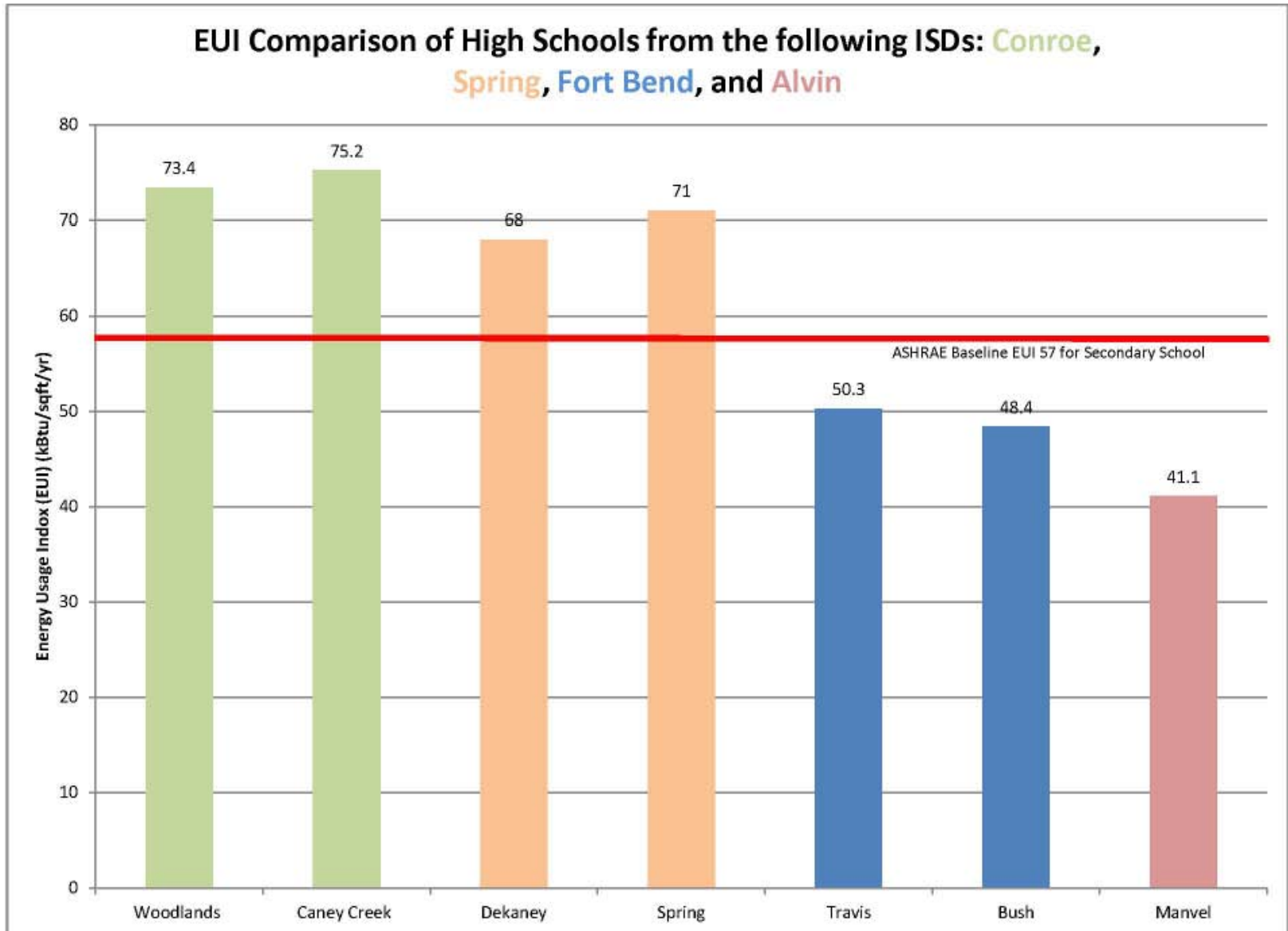
- Track utility bills using a standard format
- Identify anomalies
- Investigate problems & re-commission
- Establish incentives for conservation
- Standardize thermostat set points

# Managing Energy Costs

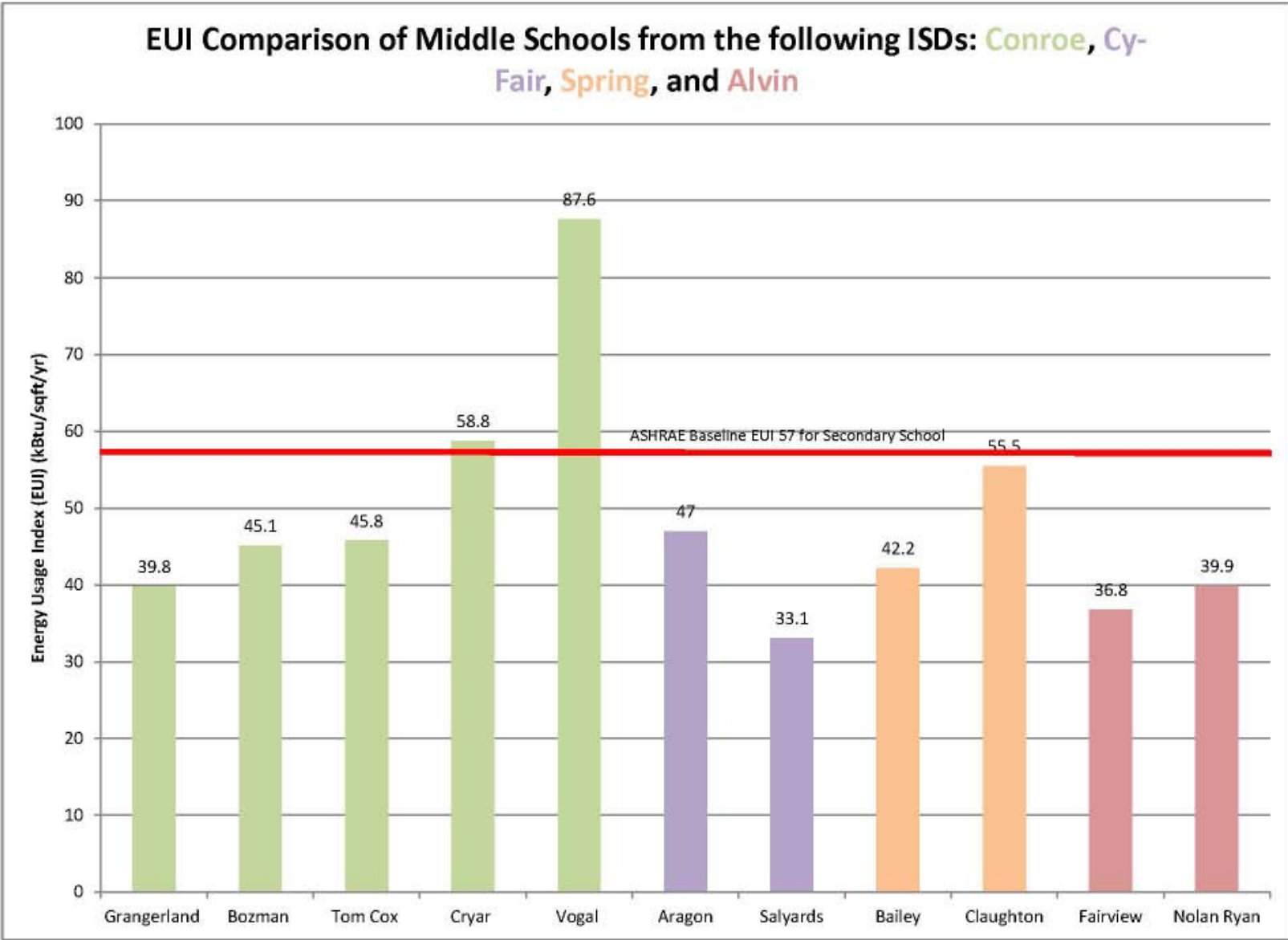
Average cost of electric and gas utilities in Texas school buildings is \$1.00 to \$2.00 per SF per year.



# Managing Energy Costs

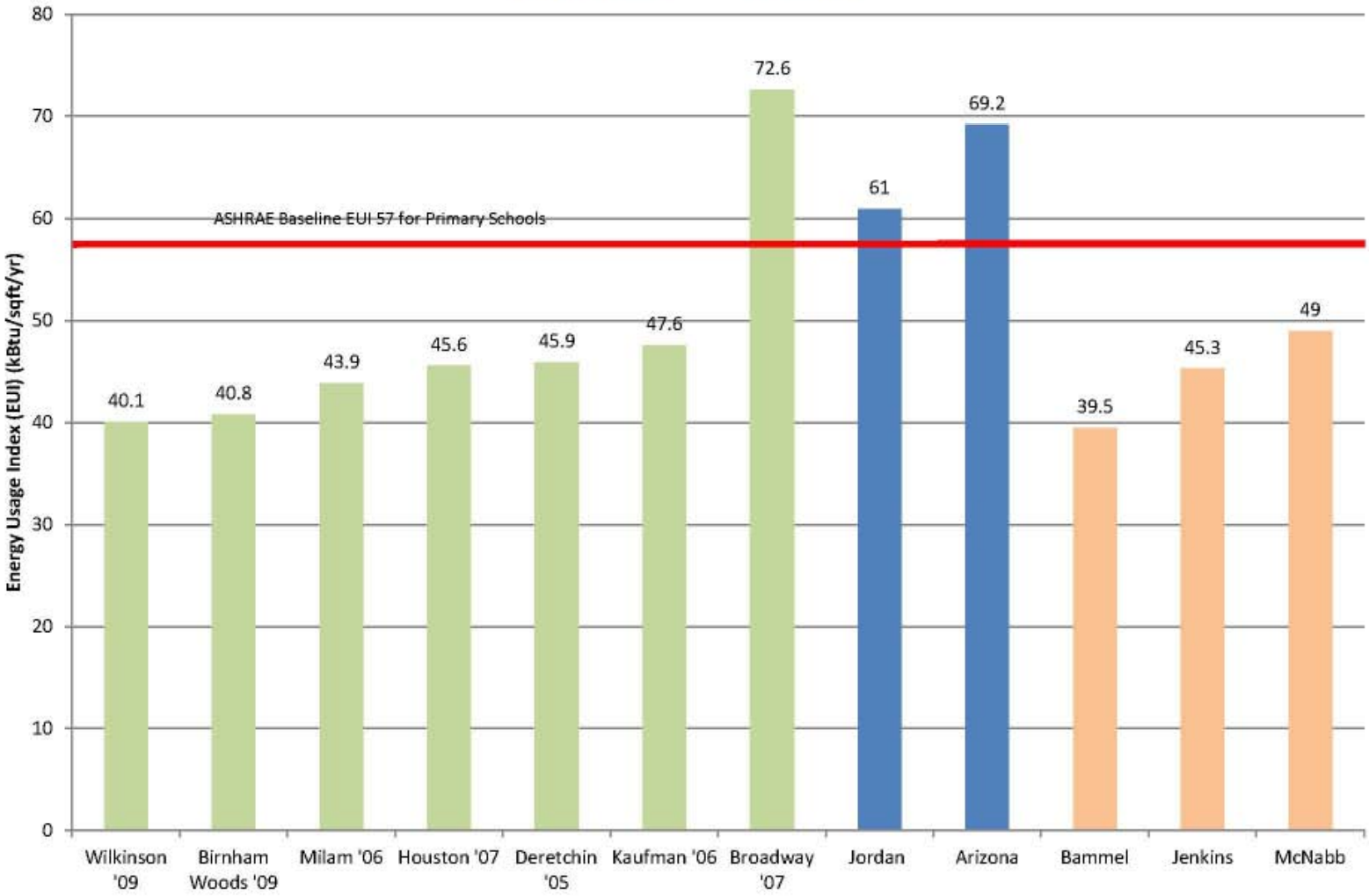


# Managing Energy Costs



# Managing Energy Costs

EUI Comparison of Elementary Schools from the following ISDs: **Conroe**, **Fort Bend**, and **Spring**





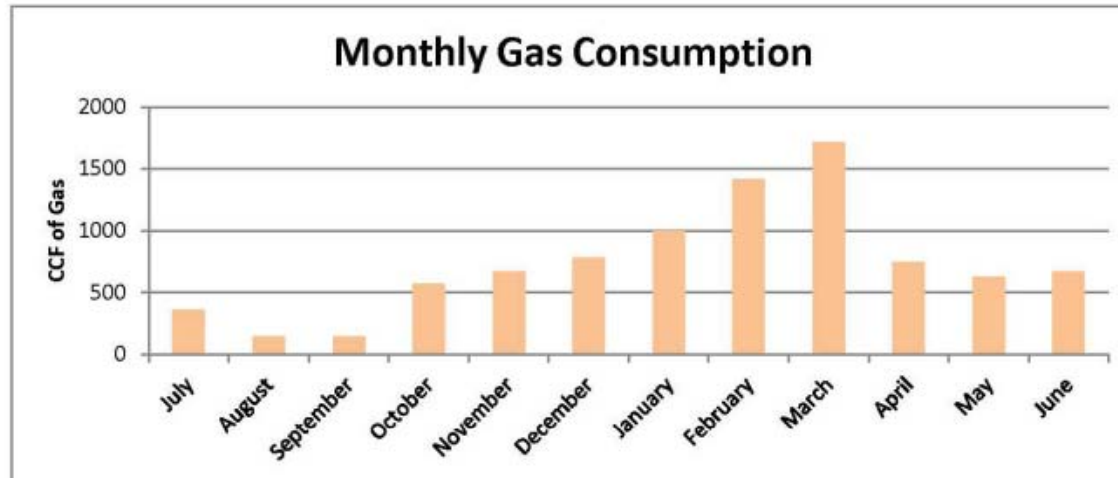
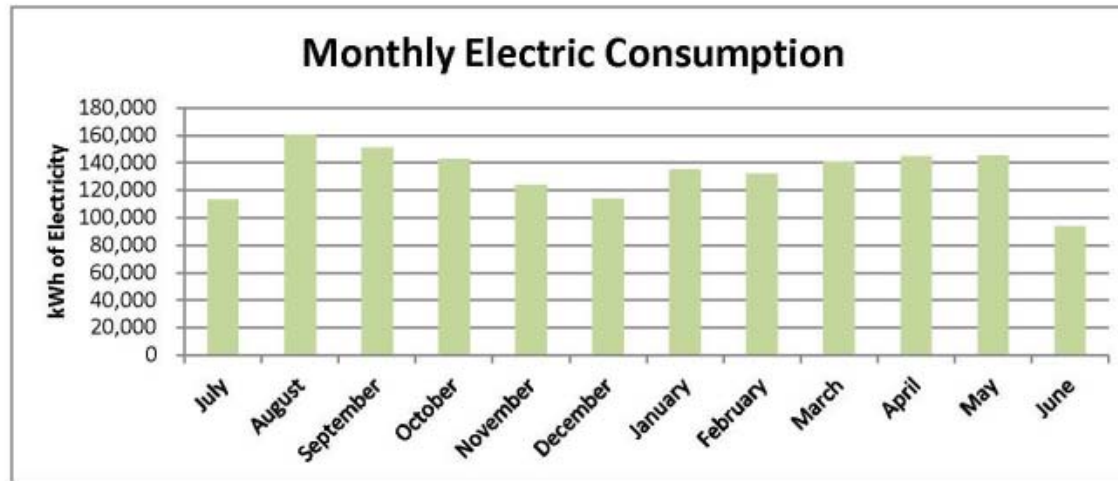
# Managing Energy Costs

## RAW DATA GIVEN BY UTILITY BILLS

Fairview Middle School 2010-2011					
July 2010 - June 2011	Electric Use	Gas Use	Water Use		
July	Use (kWh)	112,979	Use (ccf)	360	Use (gal)
	Cost (\$)	14,088.00	Cost (\$)	239	Cost (\$)
August	Use (kWh)	160,528	Use (ccf)	150	Use (gal)
	Cost (\$)	17,792.00	Cost (\$)	108	Cost (\$)
September	Use (kWh)	151,256	Use (ccf)	150	Use (gal)
	Cost (\$)	16,408.00	Cost (\$)	114	Cost (\$)
October	Use (kWh)	142,840	Use (ccf)	570	Use (gal)
	Cost (\$)	15,715.00	Cost (\$)	388	Cost (\$)
November	Use (kWh)	124,214	Use (ccf)	670	Use (gal)
	Cost (\$)	14,392.00	Cost (\$)	454	Cost (\$)
December	Use (kWh)	113,810	Use (ccf)	780	Use (gal)
	Cost (\$)	14,177.00	Cost (\$)	524	Cost (\$)
January	Use (kWh)	135,006	Use (ccf)	1000	Use (gal)
	Cost (\$)	15,170.00	Cost (\$)	625	Cost (\$)
February	Use (kWh)	132,136	Use (ccf)	1420	Use (gal)
	Cost (\$)	14,734.00	Cost (\$)	877	Cost (\$)
March	Use (kWh)	141,236	Use (ccf)	1720	Use (gal)
	Cost (\$)	15,698.00	Cost (\$)	1062	Cost (\$)
April	Use (kWh)	144,908	Use (ccf)	750	Use (gal)
	Cost (\$)	16,094.00	Cost (\$)	477	Cost (\$)
May	Use (kWh)	145,320	Use (ccf)	630	Use (gal)
	Cost (\$)	16,639.00	Cost (\$)	404	Cost (\$)
June	Use (kWh)	93,996	Use (ccf)	670	Use (gal)
	Cost (\$)	12,794.00	Cost (\$)	428	Cost (\$)
<b>Total</b>	<b>Use (kWh)</b>	<b>1,598,229</b>	<b>Use (ccf)</b>	<b>8,870</b>	<b>Use (gal)</b>
	<b>Cost (\$)</b>	<b>183,701</b>	<b>Cost (\$)</b>	<b>5,700</b>	<b>Cost (\$)</b>

# Managing Energy Costs

**MONTHLY CONSUMPTION GRAPHS**  
Fairview Middle School – Alvin ISD – 10/11



# Managing Energy Costs

## Fairview Middle School - 2010-2011 ENERGY USE INDEX (EUI)

Electricity		
Electricity kWh	1,598,229	kWh x 3.412 = kBtu
kBtu/kWh	3.412	
kBtu Site	<b>5453157.35</b>	
Natural Gas		
Meter Reading (CCF)	8870	
Therms/CCF	1.025	CCF x 1.025 = Therms
Therms	9091.75	
100 kBtu/Therm	100	Therms x 100 = kBtu
kBtu Site	<b>909175</b>	
Combined kBtu	<b>6362332.35</b>	Combined Electricity and Natural Gas
site sqft	172843	
<b>EUI (site)</b>	<b>36.8</b>	kBtu/sqft/yr
<b>ASHRAE 2009 Benchmark EUI for a K-12 School is 57</b>		

## ENERGY STAR RATING

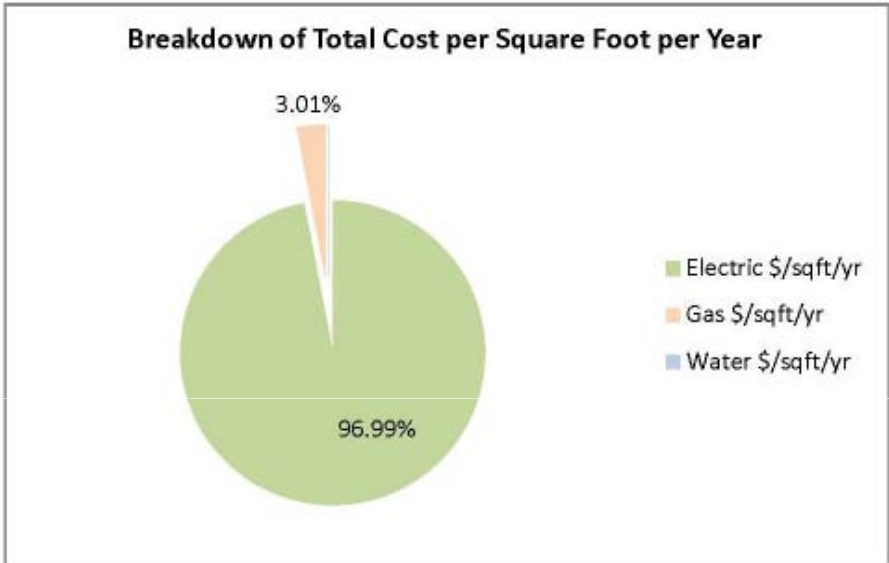
Electricity kBtu Site	5453157.35	
kBtu Source/kBtu Site	3.34	Multiplier Given by Energy Star
Electricity kBtu Source	18213545.5	
Natural Gas kBtu Site	909175	
kBtu Source/kBtu Site	1.047	Multiplier Given by Energy Star
Natural Gas kBtu Source	951906.225	
Combines kBtu Source	19165451.8	
site sqft	172843	
<b>EUI (source)</b>	<b>110.883587</b>	

K-12 Schools that achieve Energy Star average an EUI of 100

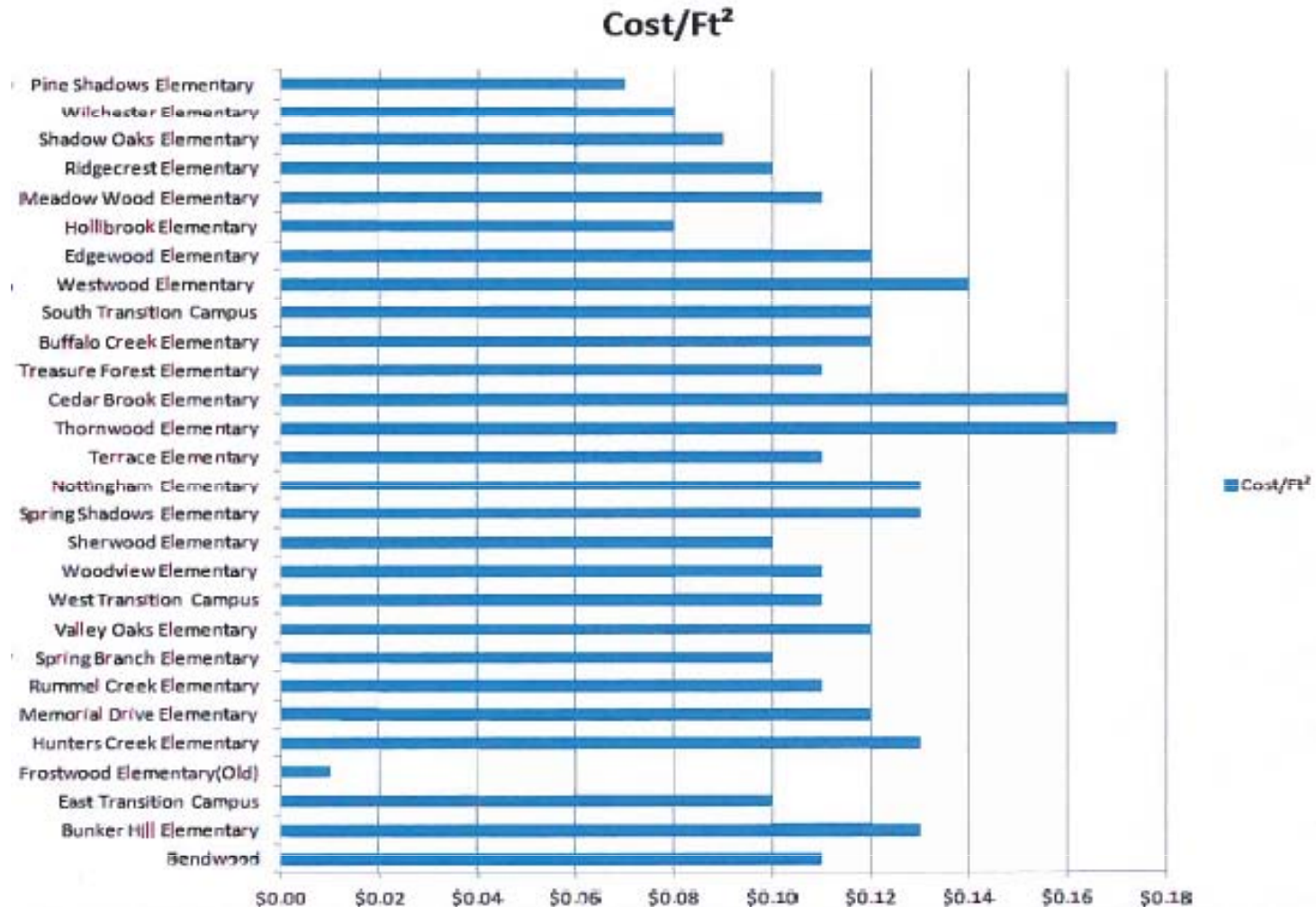
# Managing Energy Costs

## Fairview Middle School 2010-2011 Utility Cost Index (UCI)

Total Electric Use (kWh)	1,598,229	Electric \$/sqft/yr	1.063								
Total Cost of Electricity (\$)	183,701	Gas \$/sqft/yr	0.033								
Total Square Footage	172843	Water \$/sqft/yr	0.000								
<table border="1"> <tr> <td>Total Gas Use (ccf)</td> <td>8870</td> </tr> <tr> <td>Total Cost of Gas (\$)</td> <td>5700</td> </tr> <tr> <td>Total Square Footage</td> <td>172843</td> </tr> </table>		Total Gas Use (ccf)	8870	Total Cost of Gas (\$)	5700	Total Square Footage	172843	<table border="1"> <tr> <td><b>TOTAL \$/sqft/yr</b></td> <td><b>1.096</b></td> </tr> </table>		<b>TOTAL \$/sqft/yr</b>	<b>1.096</b>
Total Gas Use (ccf)	8870										
Total Cost of Gas (\$)	5700										
Total Square Footage	172843										
<b>TOTAL \$/sqft/yr</b>	<b>1.096</b>										
<table border="1"> <tr> <td>Total Water Use (gal)</td> <td>0</td> </tr> <tr> <td>Total Cost of Water (\$)</td> <td>0</td> </tr> <tr> <td>Water Use Index</td> <td>0.00</td> </tr> </table>		Total Water Use (gal)	0	Total Cost of Water (\$)	0	Water Use Index	0.00				
Total Water Use (gal)	0										
Total Cost of Water (\$)	0										
Water Use Index	0.00										

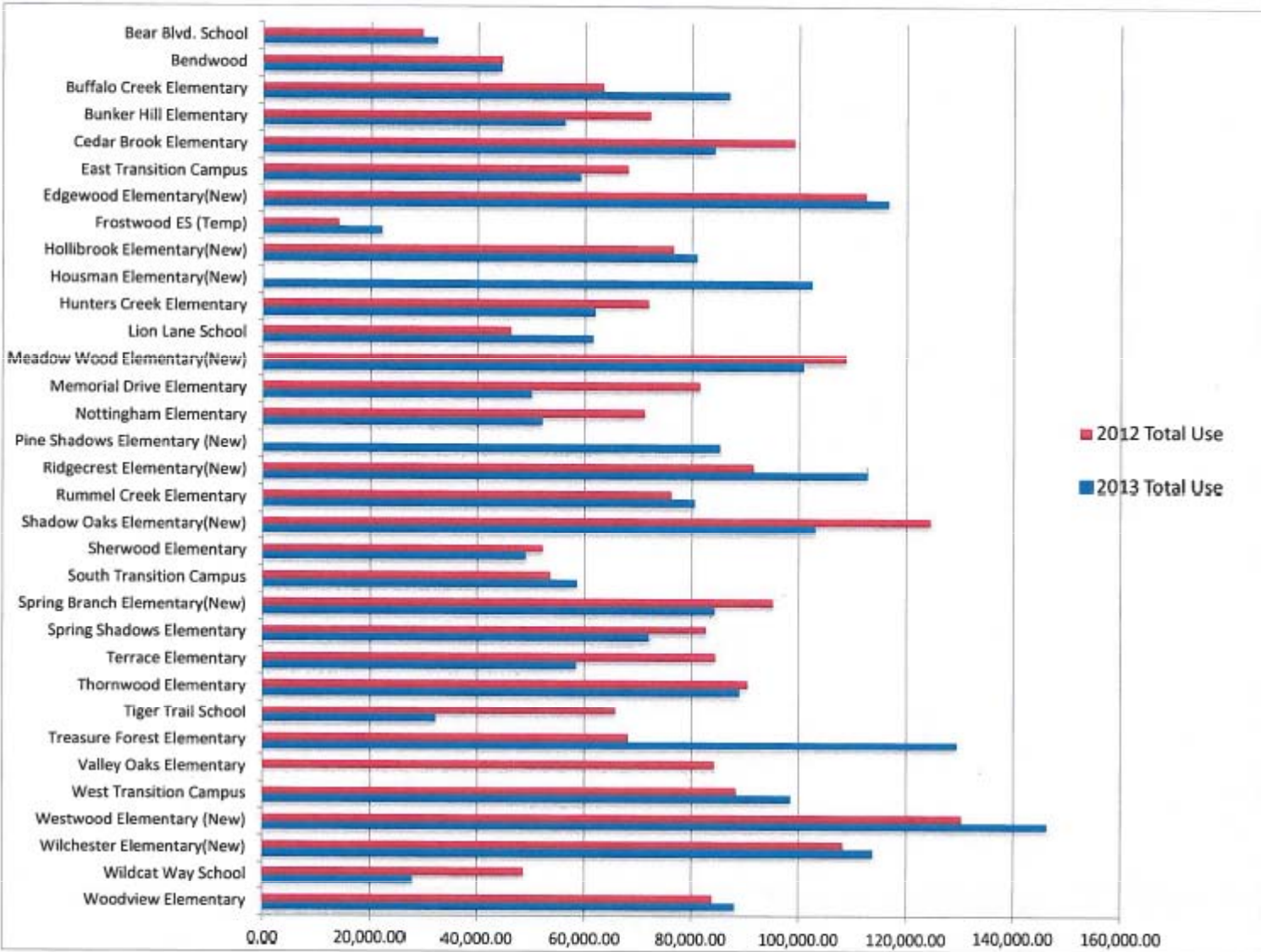


## Energy Use Index Elementary

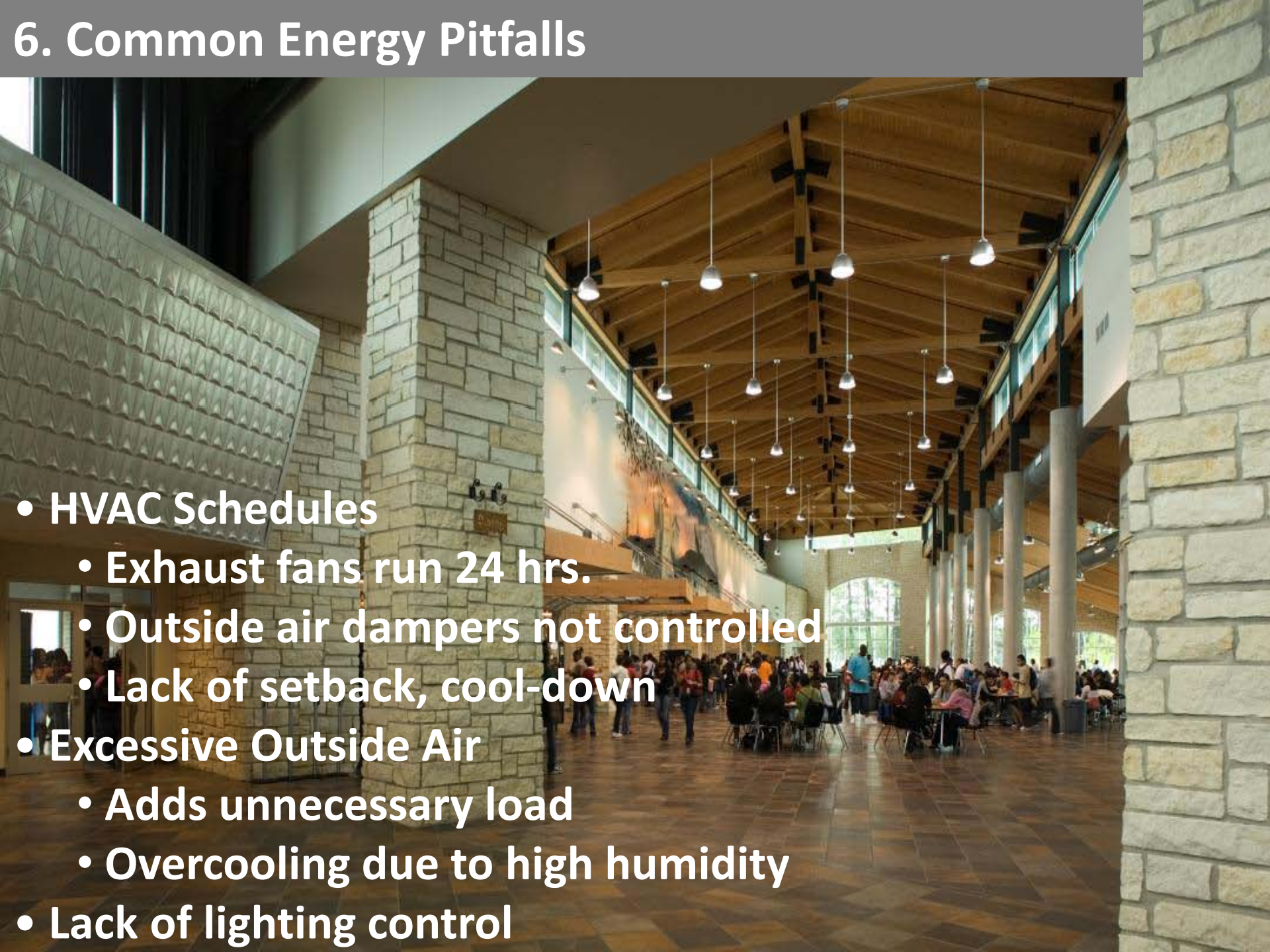


# Managing Energy Costs

SBISD Elementary Schools  
Electricity Usage (kWh)



## 6. Common Energy Pitfalls

- HVAC Schedules
    - Exhaust fans run 24 hrs.
    - Outside air dampers not controlled
    - Lack of setback, cool-down
  - Excessive Outside Air
    - Adds unnecessary load
    - Overcooling due to high humidity
  - Lack of lighting control
- 

# Top 10 No-Cost Ways To Lower Your School's Utility Bills

1. Establish and communicate a policy
2. Benchmark your school
3. Assign responsibility for common areas
4. Establish a recognition program
5. Control classroom thermostats
6. Use building automation systems (BAS)
7. Turn off outside lighting
8. Establish a plug load plan
9. Keep doors and windows closed
10. Control exhaust fans



# 1. Establish and Communicate a Policy

- Connection to business plan
- Roles and responsibilities
- Temperature set points
- Use of computers/equipment (school & personal)
- Vacation shutdown guidance
- Benchmarking
- Awareness and training
- Sustainable Energy Efficiency committee



## 2. Benchmark Your School

### Four Easy Steps

1. Go to [www.energystar.gov](http://www.energystar.gov) and register for a Portfolio Manager account.
2. Add a “property” (your school).
3. Add a “space” (your school space attributes).
4. Enter at least 12 months of energy use data.

You will receive a rating (from 1 to 100) that compares your school with a national average (50).



[Portfolio Manager Login Page](#)

# 3. Assign Responsibility for Common Areas

## Common Areas

- Hallways
- Multipurpose rooms
- Cafeterias
- Auditoriums
- Restrooms
- Gymnasiums
- Locker rooms
- Conference/meeting rooms
- Stage
- Storage areas

Bright Elementary School Common Areas Check List	
Space:	<b>Cafeteria</b>
Monitor:	<b>Ms. Jones</b>
X	Lights
X	Doors/Windows
N/A	Computers
X	Temperature Settings
N/A	Water Fixtures
N/A	Exhaust Fans
Notes:	



## 4. Establish a Recognition Program

- Appreciation for a job well done.
- Award ceremonies give visibility to the program.
- Recognize energy saving behaviors at staff and faculty meetings.
- Encouraged to help and see it as a priority.



# 5. Control Classroom Thermostats



## Manual

- Set for comfort during class time
- Establish range (e.g. 72 to 78 F)
- Set back at night and weekends (by 8 to 10 F)



## Programmable

- Establish range
- Periodically inspect settings
- Over-rides

 **1 Degree = 1% Energy Cost**

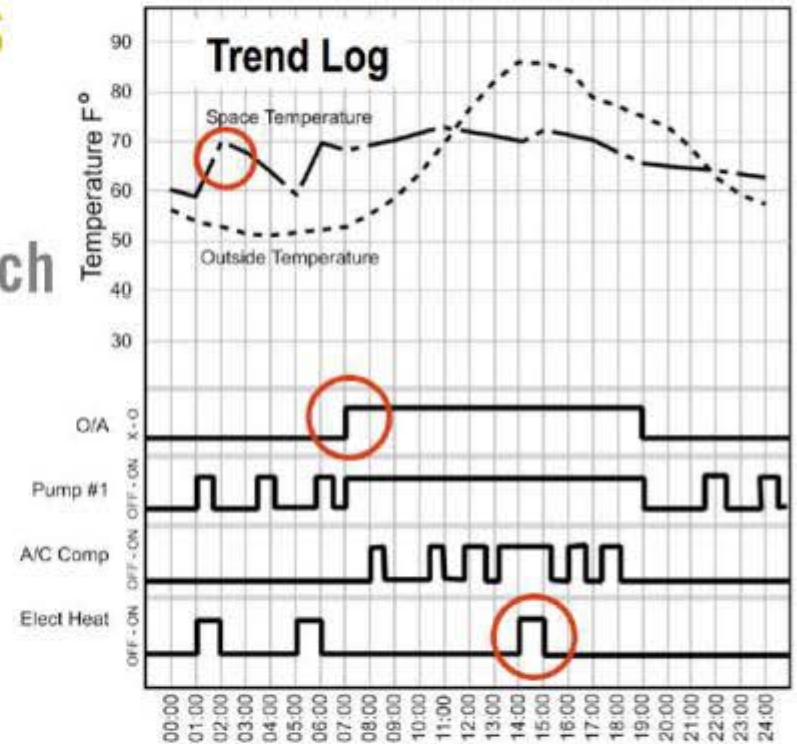


# 6. Use Building Automation Systems (BAS)

## Control System Capabilities

- Program settings
- Assess trouble prior to dispatch
- Optimize system settings\*

\*Requires a technician



## 7. Turn Off Outside Lighting (Midnight to 6 AM)

### Purpose of outside lighting

- Staff safety
- Crime prevention
- Extra-curricular activities

### National Crime Prevention Council 350 Tested Strategies to Prevent Crime

- A dark campus seems to deter vandals
- Dark or lit does not seem to make a difference for larcenies



# 8. Establish a Plug Load Plan

## Plug Load Management Plan

1. PC power settings
2. PC security patch management
3. Vending machine power control
4. Standby power
  - Use of power strips
  - Unplug when not in use
  - Office equipment
  - ENERGY STAR rated
5. Seasonal shut down
6. Refrigerators
7. Kitchen equipment
8. Water heaters





## 8. Establish a Plug Load Plan

Plug loads can account for as much as 20% of the power load in schools.



# 9. Keep Doors and Windows Closed

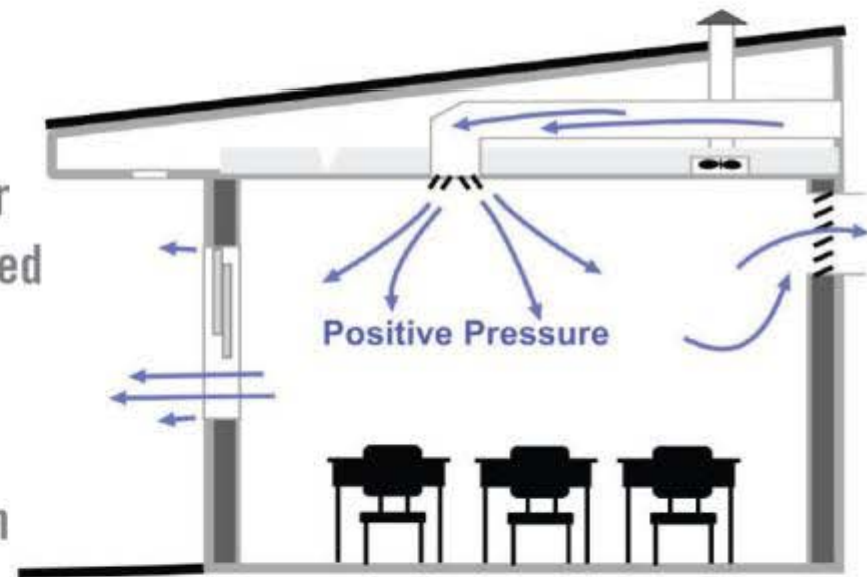
Penetrations in the building envelope can increase the cooling and heating load of mechanical equipment.

## 1. Positive Pressure

Most schools are designed for positive pressure. Open windows (or improperly sealed) cause conditioned air to vent to the outside.

## 2. Inspect O/A Dampers

Outside air dampers can be stuck in the open position.

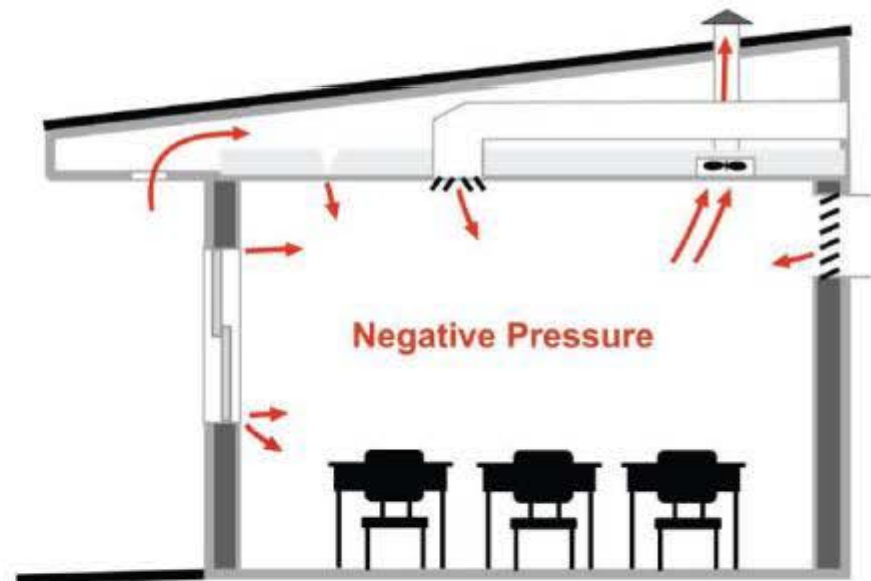


# 10. Control Exhaust Fans

When the building's ventilation system is off, exhaust fans can create a negative pressure.

## Negative Pressure

Outside air can enter through numerous cracks and holes in the building envelope – bringing in unwanted temperatures and humidity levels.





**QUESTIONS**

**ANSWERS**

