Energy Smart Schools

…and what we can do to get there…

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Smart Energy Design Assistance Center (SEDAC)

Presentation Overview

I. Brief SEDAC Background
II. Basics of Energy Auditing
III. Top Recommendations for Schools
IV. Overview of Incentives
V. Questions

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I. SEDAC Background

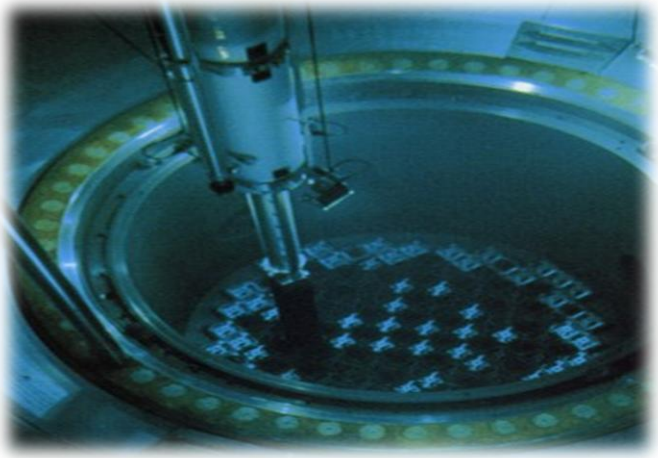
- Smart Energy Assistance Center at the School of Architecture's Building Research Council (BRC) of the University of Illinois Urbana-Champaign
- Program sponsored by the Illinois Department of Commerce and Economic Opportunity (DCEO).
- Funded through the Energy Efficiency Portfolio Standard which requires utility companies to reduce energy demand.
- Program targets buildings for Illinois businesses (commercial and industrial), municipalities, schools, and colleges.

II. Basics of Energy Auditing

1. What is Energy?
2. Analyzing the utility bills
3. Benchmarking
4. Gather information

What is Energy?

Energy is a substance (or property) which can be converted into work.



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What is Power?

Power is energy per a unit of time.
Power is a rate.

Water analogy:
Power is the flow of water, where as energy is the amount of water in the tub.

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Energy and Power Terms

Btu – Measures thermal energy (natural gas). Raise the temperature of one pound of water 1° F. (1 match)
Btuh – Thermal energy over time
Therm – 100,000 Btu, heat energy sources such as natural gas and steam may be sold in therms.
Watt (W) – a measure of electrical power. i.e. energy to heat 1 gram of air 1°C in one second.
Kilowatt (kW) –1,000 watts, it is also equal to **3,412 Btuh**
Kilowatt-hour (kWh) - A kilowatt-hour is the quantity of energy delivered when power flows at the rate of one kilowatt for one hour.

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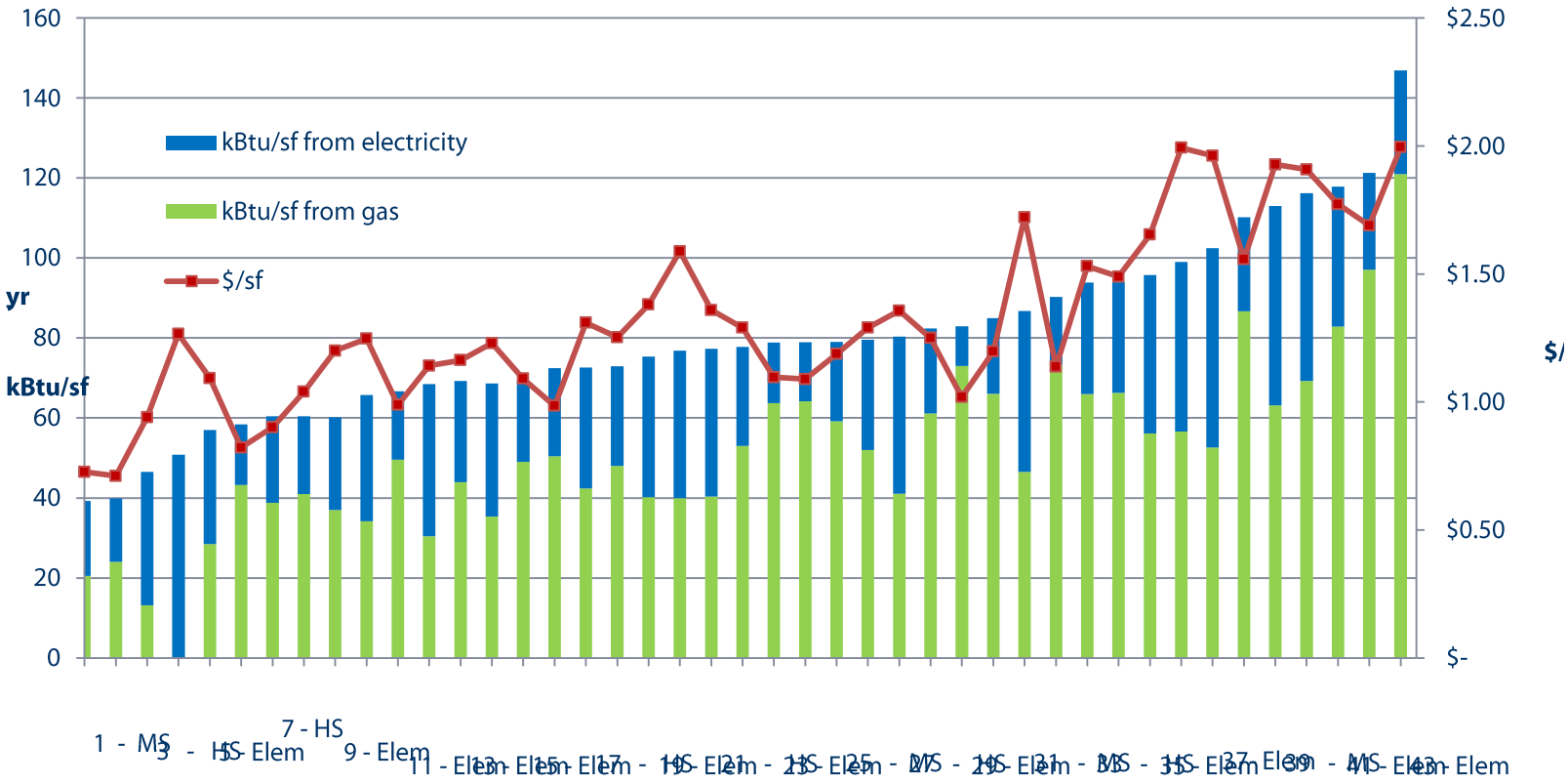
Why Save Energy?

- It is cheaper to invest in energy efficiency than pay for energy over the long term
- Who should get your money? The utilities or your education funds
- Example:
  - ✓ If total annual utilities = $1.6M
  - ✓ 10% energy savings = $160,000
  - ✓ Roughly enough to hire three new teachers, buy 300 new computers or purchase 7,000 new textbooks.

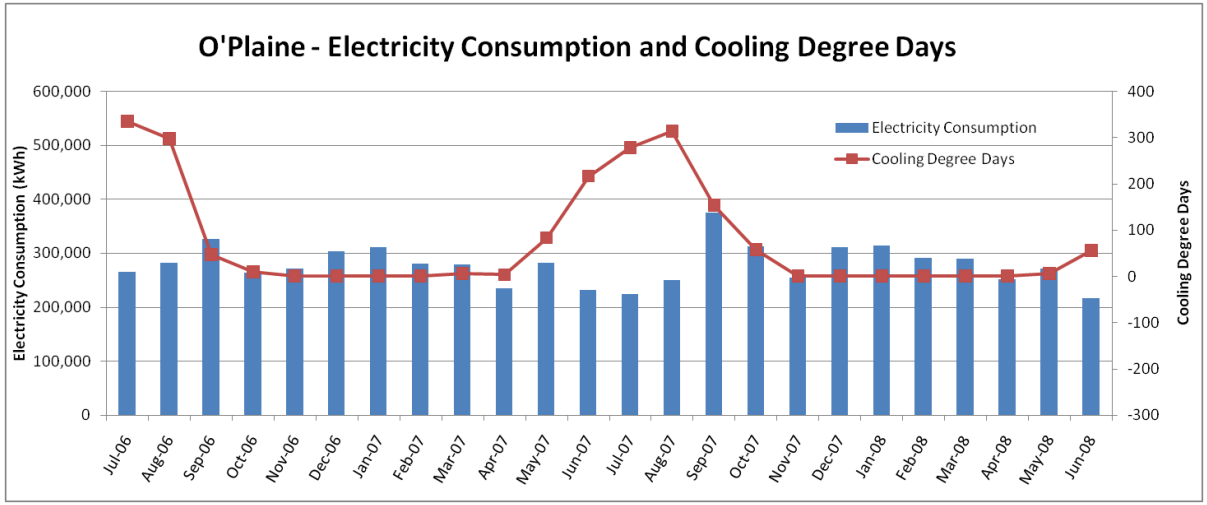
Benchmarking

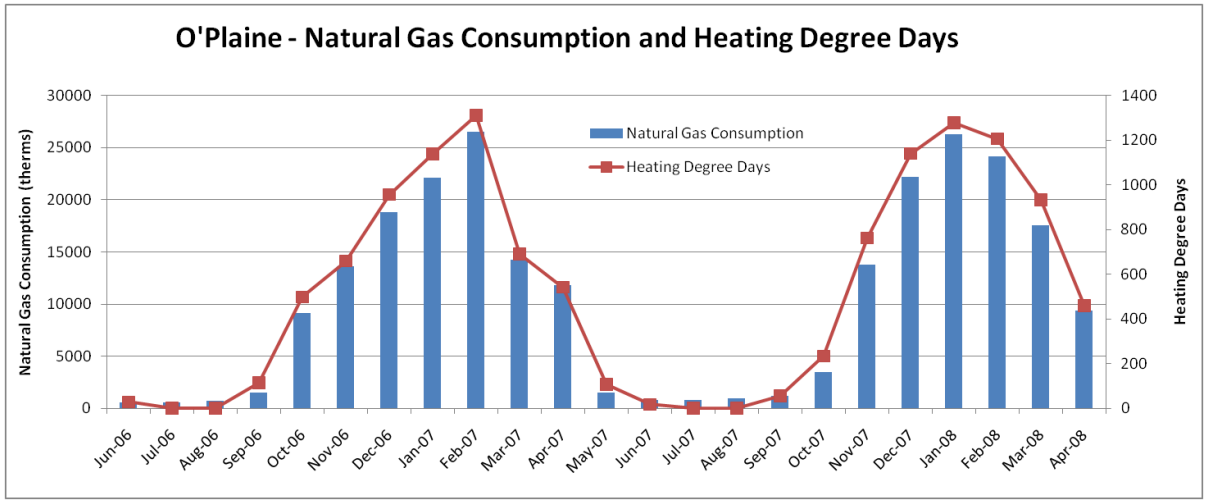
- How does my building perform compared to others?
- Use your past utility bills to calculate.
- Quick (depends on energy price)
  - $ per square foot
    - **< $1/sf = good**
    - **$1 to $2 = fair (typical)**
    - **$2 to $3 = room for improvement**
    - **Greater than $3 is HIGH!**
- More Accurate
  - kBtu/sf per year
  - Use TargetFinder (www.energystar.gov)

Illinois School Benchmarks (K-12)



Utility Analysis





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III. Energy Efficiency in Schools

Typical Recommendations focus on:

- Building Envelope
  - Walls
  - Roof
  - Windows
  - Floors
- Lighting
- Heating, Ventilating, and Air Conditioning (HVAC)
- Internal and Process Loads (cooking, hot water, swimming pools, laboratories, food service, vending, etc.)

Lighting

- Lighting Power Density 1.2W/sf maximum.
- <1.0W/sf preffered
- Direct/Indirect lighting helps reduce LPD
- Combine with daylighting wherever possible
- Add controls to allow for lower light levels where possible.

Low Wattage T8s and T5s

- T12 planned phase out
  - Magnetic ballasts no longer made.
  - Lamps – July 2012
- Improved lighting quality
- Retrofit has energy savings as **high as 40%** over standard T8.
- 28W T8s (actually called 32W).
  - Make sure they are compatible with ballasts.
- 25W T8s (also 32W) coming on the market
- T5 – Great for new fixtures, harder to retrofit

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HID to Fluorescent Retrofit

- Existing System:
  - 400watt High Pressure Sodium and 400watt Metal Halide.
  - Each fixture uses 460 watts (400 for lamp, 60 for ballast)
- Retrofit
  - One-for-one replacement
  - 6-lamp fluorescent
  - Each fixture uses 234 watts (lamps and ballast combined)
  - Light levels increase 10-20%
  - Long life
  - Better visibility

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LED Exit Signs

- Payback is quick
- Rebates available
- Very basic lighting energy savings measure
- Chicago approved
- Change from incandescent at >28W to LED at <2 W

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Street and Parking Lighting

- Probe Start HID to Pulse Start HID
- Fluorescent, Induction, and LEDs are starting to become viable options.

Occupancy Sensors

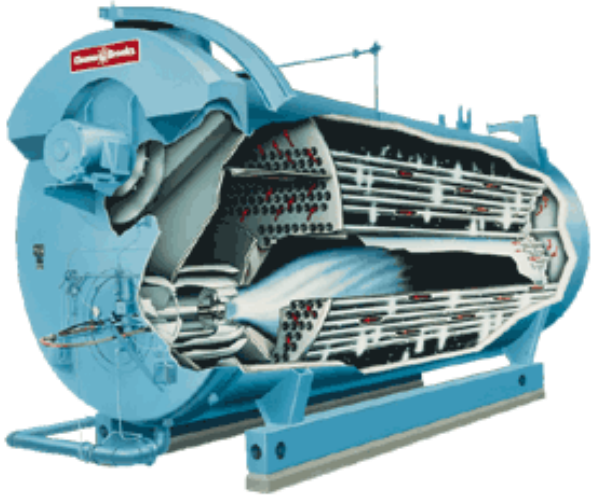
- Use them for:
  - Classrooms
  - Offices
  - Restroom lighting
  - Storage Areas
  - Mechanical Rooms
- Get creative – use for HVAC in individual rooms or zones.
- Wireless sensors now available

New vs. Existing HVAC System

- New Options
  - Geo Thermal (Ground Source Heat Pump)
    - Most efficient, most expensive
  - VAV (Variable Air Volume)
    - With proper controls are very efficient
  - Cold Climate Heat Pump
    - Potential to be as efficient as GSHP
- Existing Options
  - Boilers - Install most efficient
  - Chillers - Need proper maintenance and controls
  - RTU to high efficiency Heat Pumps
  - Controls

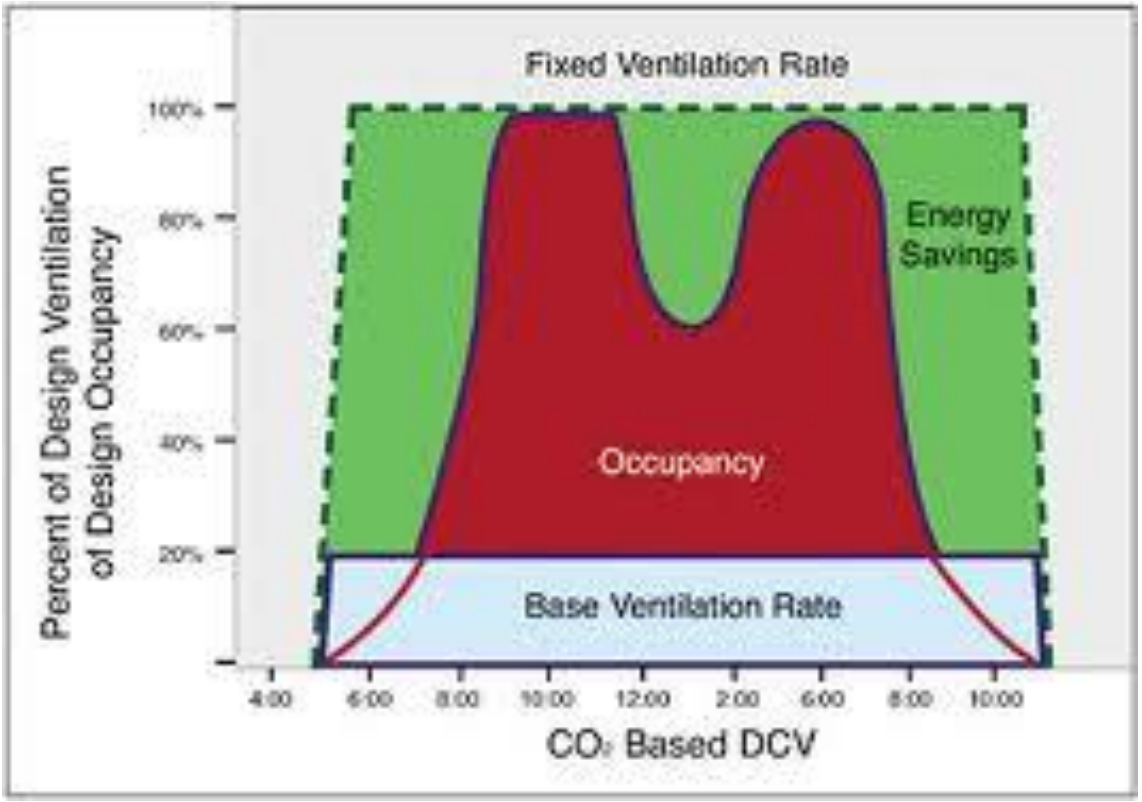
Boilers and Chillers

- Chillers
  - Shut down chillers when OA temperatures are consistently below 50, and use economizer.
- Water supply temp reset in mild weather
  - Lower boiler water temperature
  - Raise chilled water temperature
- Boilers
  - Don't start boilers until OA temperatures are below 50 consistently.
  - Install modular high-efficiency condensing boilers
  - Consider shutting down boilers used for AC reheat in the summer or resetting the supply water temperature.
- Older Equipment
  - Begin to plan for replacement now!



Demand Controlled Ventilation

- Very large savings!
- Only bring in required amount of fresh air.



Programmable Thermostats

- Set Heating to 68 F, set-back to at least 60 during unoccupied periods. Let condensation be your guide.
- Set cooling to 74, set-up to 80 during unoccupied periods. Developing morning recovery schedule based on demand charges or system capacity.
- Easy to do on systems without reheat.
- Work with recovery times to determine best fit for your building and system
- **Useless unless they are programmed.**

Electric Motors

Replace motors with premium motors rather than rewinding them.

- **Immediate replacement**
  - Any new motor should be premium efficiency
  - If used > 4000 hours per year
  - Low efficiency or not reliable
  - >50 hp and has been rewound 3 times
- **At failure**
  - Used 2000 – 4000 hours per year
  - Currently in good condition
- **Do not replace**
  - Used less than 2000 hours per year
  - Can be rewound (lose efficiency)

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Commissioning

- Commission new buildings
- Retro- or Re-commission existing buildings
- Uof I has saved 20% of energy use with paybacks less than 1 year on retrocommissioning

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Increase Envelope R-Values

- Insulate Walls to at least R-13 + R-7.5 c.i.
- Insulate Roofs to at least R-20, Attics to R-38.
- Floors over unconditioned spaces to R-30.
- These are code <u>minimums.</u>
- Highly Efficient Buildings will have values which exceed these.

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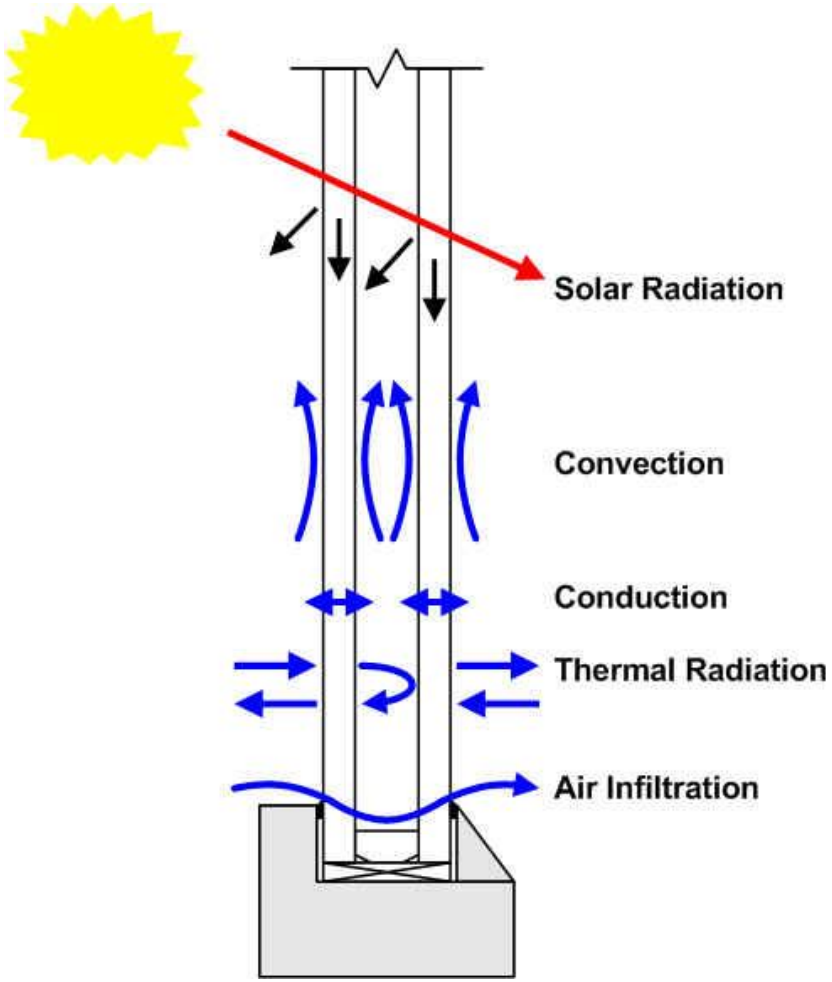
Window Characteristics

- Key parameters:
  - U-Factor ↓
  - Solar Heat Gain Coefficient (SHGC)↓
  - Visual Light Transmittance (VLT)↑
- Low-e
  - The “e” stands for emissivity
  - Transmits light but block heat.
- Gas fill
  - Air, Argon, Krypton



Window Characteristics

- Insulating shades
  - Insulating shades are costly but might be a viable retrofit
- Glare Protection
- Open to let light in when appropriate (turn lights off)
- Close at night to hold heat in
- Low-e films can be added to existing windows
- Tints don't help save energy

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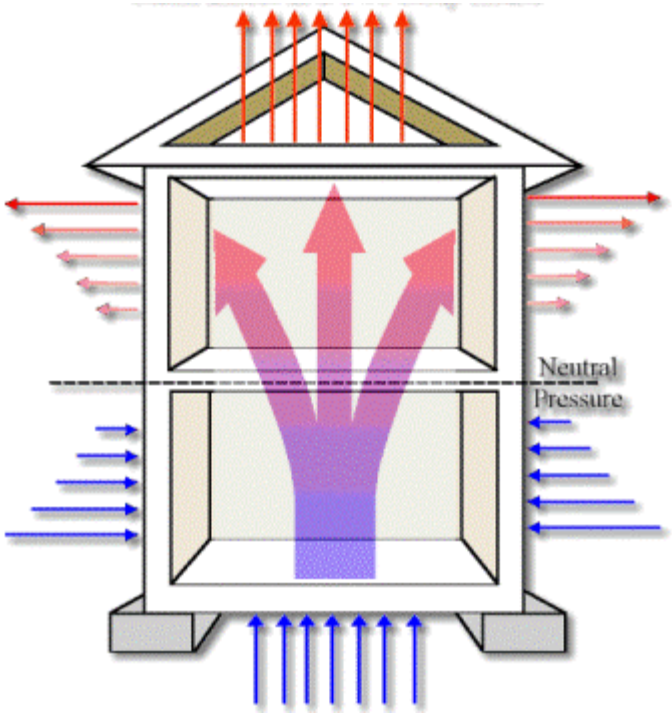
Air Sealing



- Air Sealing is just as important in a school as it is in your home – maybe even more!
- Wind and Stack effects are greater in multi story buildings.
- Warm air rises, sucking more air in low while it pushes air out high.

Manage Plug Loads

12:00

- Personal Occupancy Sensor
- Know what can be turned off
- Phantom loads
- Kill-A-Watt meter
  - Great for classes!

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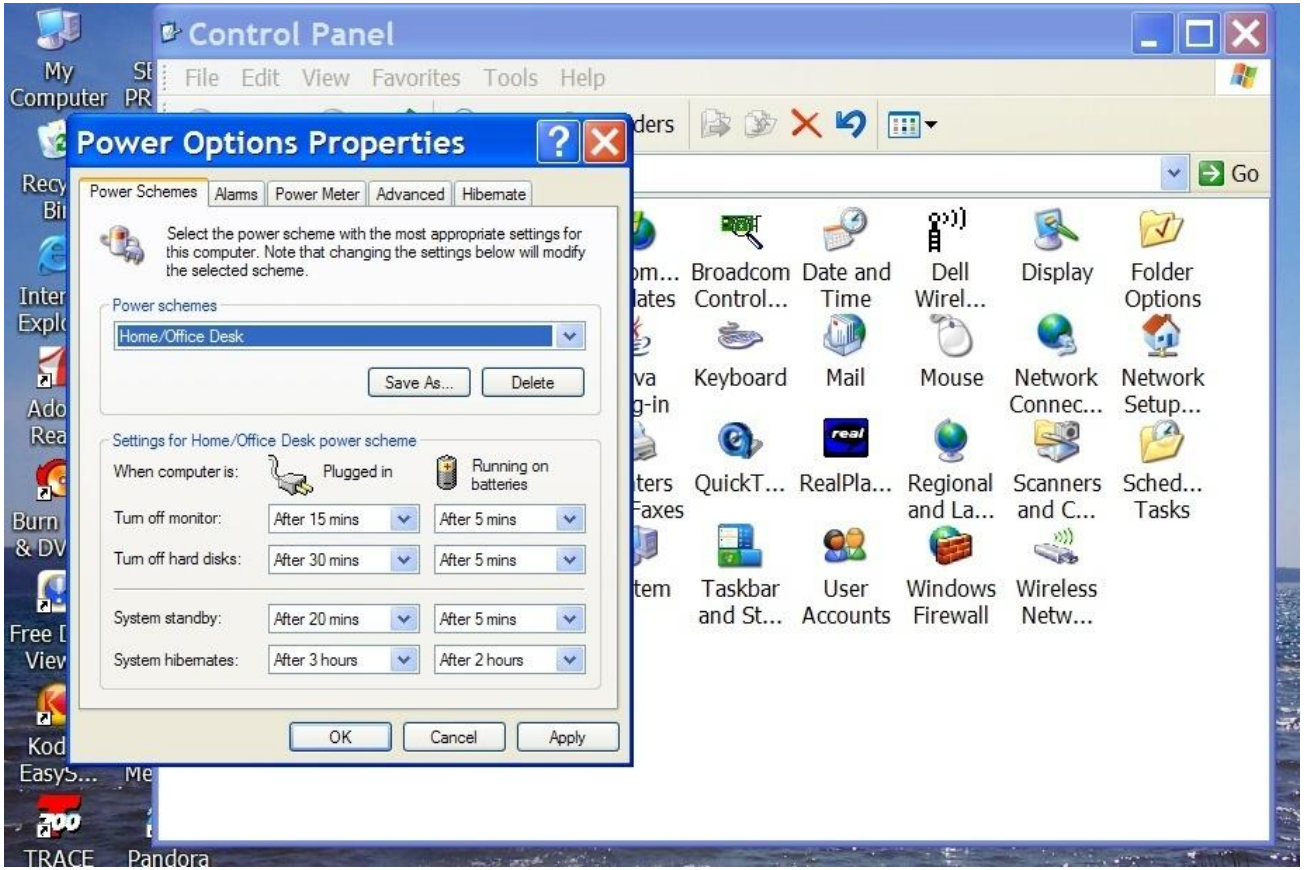
Computer Power Management



Vending Energy Management

- Install vending Energy Management systems on all drink and snack vending machines.
- Rebates are available of $100 per beverage machine and $30 per snack machine (which cost $79 each)

Water Savings Measures

- Saves water and energy costs
- Domestic Water
  - Faucet Aerators
  - Low Flow Shower Heads
  - Low Flow Water Closets
  - Low Flow Urinals

Lower Water Heater Temperature

- Set domestic water heater temperature to 120 F. Use gas fired booster heater where higher temp is required.
- Insulate pipes and tank.
- ~ 1% savings per degree reduced per 8 hours used

Energy Efficiency then Renewables

- Once you have reduced your loads as much as possible – only then look at renewables!
- Watch for available grants through DCEO, ICECF, and ISBE.

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“No-Cost” Strategies

- Benchmark Schools
- Free strategies:
  - **Turn off lighting**
  - **Control thermostats**
  - **Establish a plug load plan**
  - **Close windows and doors when HVAC is ON**
- Establish a recognition program
- Savings from 10 – 15%

IV. Overview of Incentives

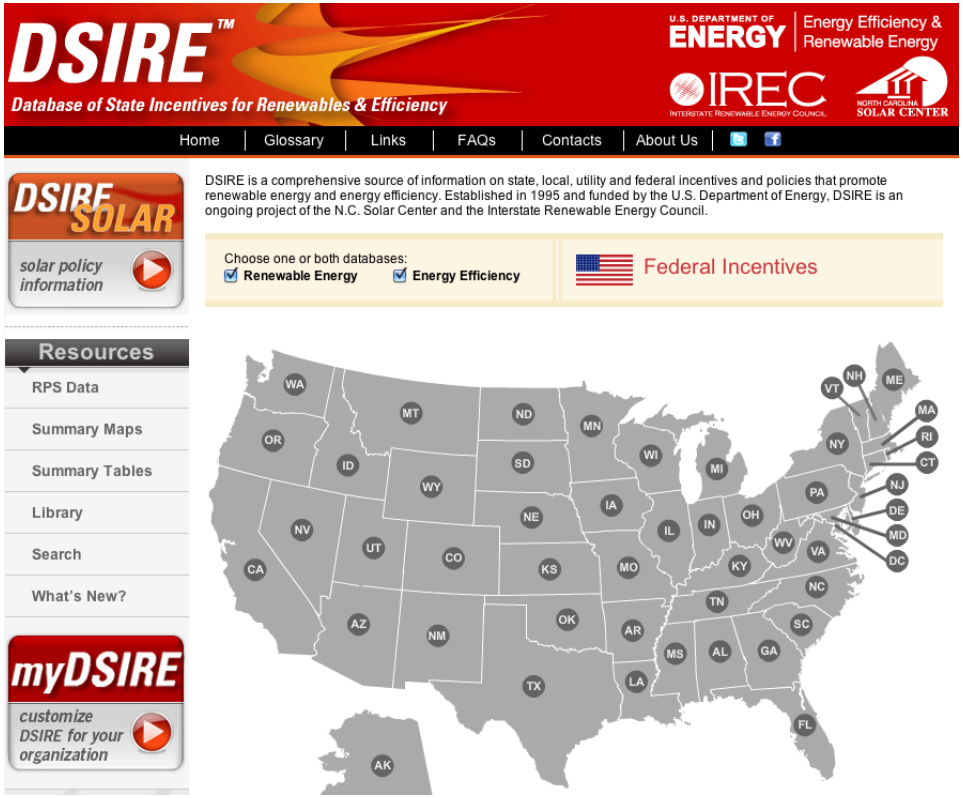
- Businesses/Organizations:
  - Act On Energy (Ameren)
  - Smart Ideas (ComEd)
  - Natural Gas coming soon
- Public Buildings:
  - DCEO

Incentives are either **standard** or **custom**.
Example standard incentives:

- Lighting
- HVAC equipment
- Controls (Occupancy Sensors)

Overview of State Incentives

Additionally the DSIRE website offers various grants and incentives periodically (http://www.dsireusa.org/)



Overview of Federal Incentives (EPAct)

A tax deduction of up to $1.80/sf for investment in energy-efficient commercial building property as part of new construction or renovations are allowed. Included are:

- Energy efficiency projects
- Renewable energy
- Fuel cells, micro turbines, and combined heat and power

The amount of the deduction is the lesser of $1.80/sf or the costs incurred or paid for the energy-efficient property.

Qualifying systems include:

1) Interior lighting systems ($0.30-0.60/sf) Most commonly pursued
2) Heating, cooling, ventilation and hot water systems (Up to $0.60/sf)
3) Building envelope (Up to $0.60/sf)

Program has been extended to January 1st, 2014.

V. Questions

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